



Farmers' Perceptions on Rabbit's Diseases and Treatment Application Trial against Ectoparasites in Kalehe, Eastern DR Congo

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Abstract

Rabbit production plays a key role in the meat production and householder revenue, but the pathological risks limit their production in the traditional systems. A study was carried out to assess the farmers' perceptions on the pathological problems in the rabbit production and assess the rate of traditional veterinary solution application on the occurrence of rabbits' lesions. Data were collected from 100 respondents through questionnaires administered to smallholder rabbits' farmers selected in the study area. Results indicated that most of our respondents are women than men, 28 years of average age, 26 months of rabbit farming experience and are mostly of the secondary school level. In addition, mange of the ears is the most frequent disease in rabbit farming and affects generally the head area. The occurrence of the lesions was the main mode of disease detection and most farmers used local solution (palmist oil + kerosene) to control the disease. The presence of lesions on organs varied with the application frequency of the product ($p = 0.000$). The palmist oil + kerosene solution applied 2 times per day (T2) reduced the amount of lesions compared to the control (T0) and thus reduces the risk of mortality (90%) compared to the control (100%) with healing. The study recommends that small-scale rabbits' farmers be supported by an ex-

tension service through the availability of good information and sanitary livestock management to improve livestock productivity.

Subject Areas

Veterinary Medicine

Keywords

Ectoparasites, Rabbit Farming, Sanitation, Pathological Risk, Traditional Livestock, Kalehe

1. Introduction

Livestock is one of the main sources of animal protein and household income in the context of reducing poverty and improving food security in resource-limited areas [1] [2]. In addition, small-scale livestock such as rabbits [3] [4] [5], guinea pigs [6] [7] [8] [9] and chicken [10] [11] [12] is one of the main strategies used in the reduction of nutritional deficiencies and poverty as this small-scale livestock has many advantages as well as limitations such as reduced spatial competition with humans, growing rapidly, doing not demand large feed inputs compared to big animals. However, [13] and [14] showed that the risk of animal diseases is known to be one of the main constraints to the improvement of the livestock sector especially in rural areas limited by the availability of veterinary products.

Rabbit is one of the most common small animals practiced by rural communities as a result of their role on the socio-economic development of the farmers [15]. Many studies indicate that rabbit have a good meat and their commercialization generates income to famers [16] [17] [18]. According to [19], rabbit manure is used as organic fertilizer in soil fertility management as is similar to cattle manure [20] [21] and pig manure [22]. However, rabbit production is affected by the occurrence of diseases causing some farmers to stop rabbit production, though they play an important role in the household income [23] [24].

Animal pathologies are known as one of the major constraints limiting the livestock sector in many regions [25] [26] [27] [28] and thus are negatively affecting the adoption of crop-livestock integration practice in some agro-ecological zones where crops and livestock production are one of the main activities for the communities livelihood's [13]. Indeed, ectoparasites are vectors of diseases causing considerable damage such as rabbit mortality due to low resistance of some rabbit breeds [29]. However, [30] showed that improved livestock systems are one of the most important factors that reduce the occurrence of ectoparasites and reduce the economic losses due to their prevalence. Thus, this study was carried out to: 1) assess the farmers' perceptions on the rabbit farming disease situation and 2) assess the application frequency of a veterinary control trial and its effects against ectoparasites in rabbits in the study area.

2. Materials and Methods

2.1. Study Area

This study was carried out at the “groupement” of South Mbinga (1°45' North and 2°29' South and its longitude is between 23°40' and 29°) in the Buhavu chiefdom (or chefferie) in the Kalehe territory, which is one of the 8 territories of South Kivu, eastern DR Congo. According to weather conditions, Kalehe has a humid tropical climate characterized by rugged topography with hill ranges varying from 1300 to over 2000 m above sea level. This area is characterized by two alternating seasons: the rainy season (September to May) and the dry season (June to August). The annual temperature varies between 18°C and 22°C with annual rainfall ranging between 1300 and 1680 mm, but the land cover change affects the climate by their variability. The Kalehe territory’s vegetation is dominated by forest including bamboo and shrubs which are frequently converted into urbanized areas, small-scale mining exploitation and agricultural land [31]. Kalehe communities generally practice small-scale crop and livestock farming, which are considered the main sources of household income [31]. The most common type of farming is family farming, which is practiced by over 70% of households. The location of study area is presented in **Figure 1**.

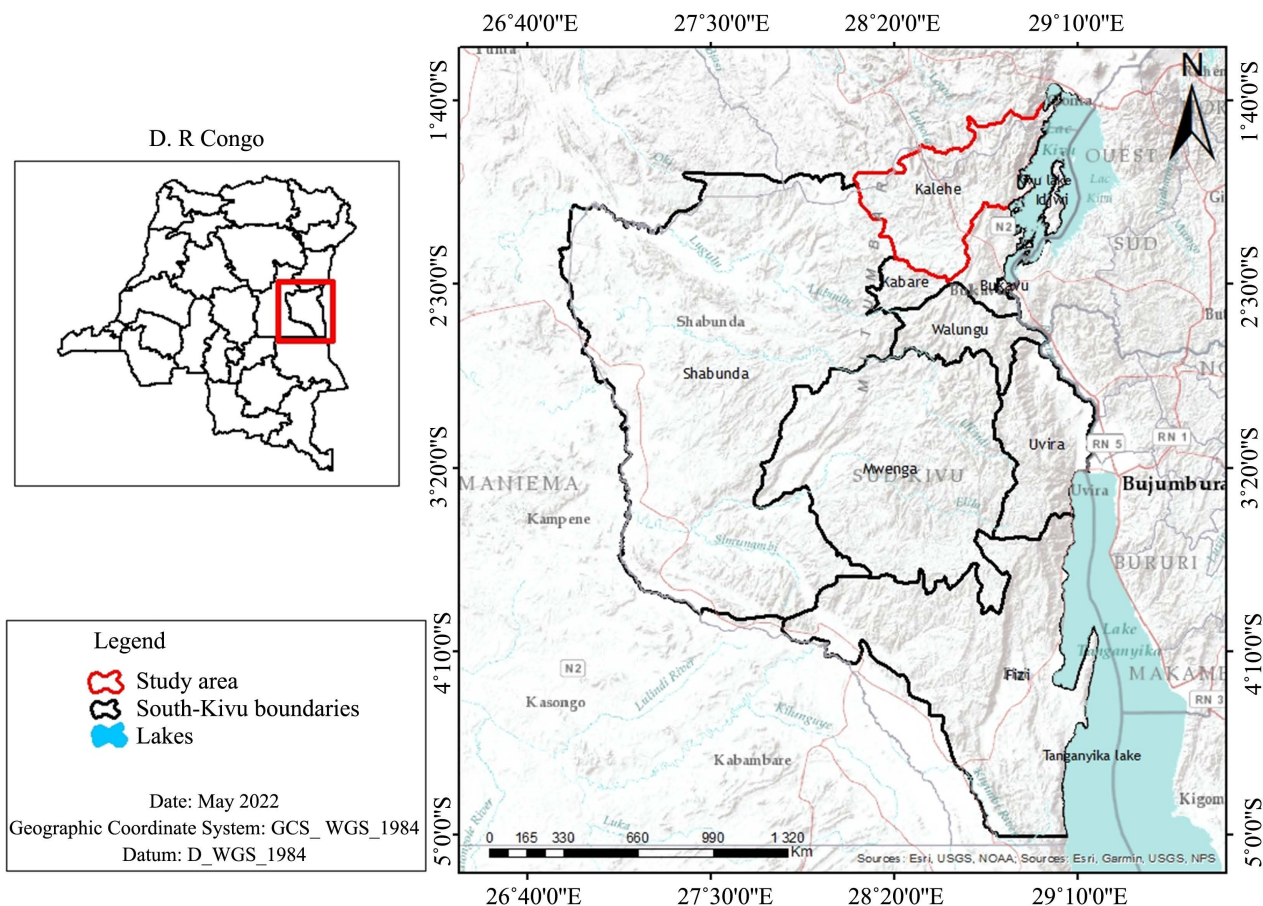


Figure 1. Location of the study area.

2.2. Methods

Sampling and data collection: The characteristics of the households, the farmers' perceptions on the rabbit diseases and the management of rabbit diseases were collected from 100 farmers randomly selected in the study area. Data collection was done in local languages (Kiswahili and Kihavu) to facilitate data collection based on the objectives.

Biological materials: In all, 36 diseased rabbits with mange symptoms and lesions including 12 rabbits treated with zero times per day of the solution, 12 rabbits treated with one time per day of the solution and 12 other rabbits treated with two times per day of the solution of palmist oil (70%) associated with kerosene (30%) and rinsing with KMnO_4 solution. The treatment solution was made according to the recommendations of the experiment study of this solution on the control of ectoparasites on guinea pigs in Walungu [6].

The Material of mixture and treatment: two (2) half-liters in plastic bottles containing the products, the chicken plume that permits the homogeneous mixture in these bottles and the application of this solution on the area presenting the mange scabies. The KMnO_4 tablets of 500 mg, after solution in water and after scrapping with a chirurgical knife, the KMnO_4 solution is applied by rinsing on the crusts.

Experimental design: The experimental design was a Randomized Complete Block Design (RCBD) with the rabbits' treatment frequency as the single factor studied. Each cage contained 1 rabbit with symptoms and lesions. In addition, 3 treatment frequencies were considered: T0: no application of the product (control), T1: one application per day and T2: 2 applications per day. Number of cages: 18, distance between cages: 0.05 m, number of rabbits per cage: 2, surface area occupied by cages: 0.06 m^2 , total surface area occupied by cages is 10.8 m^2 and total number of rabbits in the trial is 36 rabbits. The cages: 18 cages made of timber and galvanized wire mesh with a wire diameter of 2.2 and 2.5 mm and a space of 13 mm between two wires to allow the passage of excrement (faeces and urine). The experimental cages on the application rate of the traditional veterinary solution are presented in **Figure 2**.

Indeed, the samples of scabs and hair on animals with lesions on the surface of the skin and which are isolated and put in cages, where we have proceeded by scraping and rinsing superficial skin crusts by KMnO_4 . The crusts are collected on the lesions preferably at the border or at several places of the skin especially around the head, back, rump, tail, genital area and interdigital area which are the preferential living places of the parasites and after these the oily solution will be put at already scraped areas.

2.3. Data Analysis

Data collection was based on the individual interview using a questionnaire combination of observations in Kalehe during May 2021. The collected data were submitted to descriptive statistical analysis and the test of correlation and



(a)



(b)

Figure 2. Rabbits in the experimental cages on the application rate of the traditional veterinary solution (palmist oil + kerosene).

significant differences were verified by the Statistical Package for the Social Science (SPSS) and the experimental data were submitted to statistical analysis by GenStat Discovery Edition 4.

3. Results

3.1. Socio-Demographic Characteristics of Rabbits' Farmers

Rabbit farmers in our study area are predominantly women (70%) compared to men (30%). Rabbit farming is practiced by young people aged on average 28 years with an average experience of 26 months, *i.e.* 2 years and 2 months and with farms having an average of 10 rabbits. Most rabbit farmers in the study area are educated to secondary level than other levels of education. Livestock (50%) and agriculture (25%) are considered as the main income sources than other activities such as trade (15%) and employment (10%).

3.2. Technical and Health Characteristics of Livestock in the Study Area

The major part of the farmers in the study area would not associate rabbits (70%) with other animal species, while 30% of the farmers said they associate their rabbits with other animal species. Rabbit ear scabies (75%) was considered the most common disease in rabbits than fleas (5%), while 20% of farmers did not observe any disease in their rabbits. Poor livestock practices were identified by a majority (50%) of farmers as the main reason for the frequency of rabbit diseases in the study area, compared to the non-use of veterinary inputs (30%)

and lack of information on good rabbit management practices (20%). In addition, 50% of the farmers used veterinary inputs for disease control and the other 50% did not use any veterinary inputs. Palmist oil combined with kerosene is the most used product (60%) compared to other veterinary products such as ivermectin (30%) and multi-vitamin (10%).

3.3. Effect of the Application Frequency of the Palmist Oil and Kerosene Combined on the Ectoparasites Control

The results of the effectiveness of the palmist oil + kerosene solution application had a significant influence on the lesions on the lips, nose, ears, eyelids and on the rest of the body parts ($p = 0.000$). Indeed, the presence of lesions was observed on the nose of the control (3 lesions) compared to T2 (0.47). In addition, the application of the solution two times per day reduced the number of lesions to 1.2 lesions while 6.13 lesions were noted on the nose of rabbits housed in the control cages. Application of the solution 2 times per day reduced the number of lesions on the ears by 0.73 lesions compared to the application of the solution 1 time per day by 3.47 lesions. Application of the solution two times per day reduced the number of lesions on the eyelids, 0.47 lesions compared with T1 (3.47 lesions). T2 reduced the number of lesions on the limbs, 0.87 lesions compared with T0 (7.2 lesions).

3.4. Evolution of Lesions on the Organs of Rabbits in Function of the Application of the Palmist Oil + Kerosene, Ivermectin and Rinsing with KMnO_4

The results in **Figure 3** show the evolution of the symptoms and lesions according to the application of the palmist oil solution combined with kerosene. Indeed, the lesions presence on the rabbit's organs changed with the frequency of the treatment of the rabbits with lesions. The lesions were reduced by applying the solution two times per day on the body parts of the rabbits compared to the other applications on the organs of the rabbits to be treated.

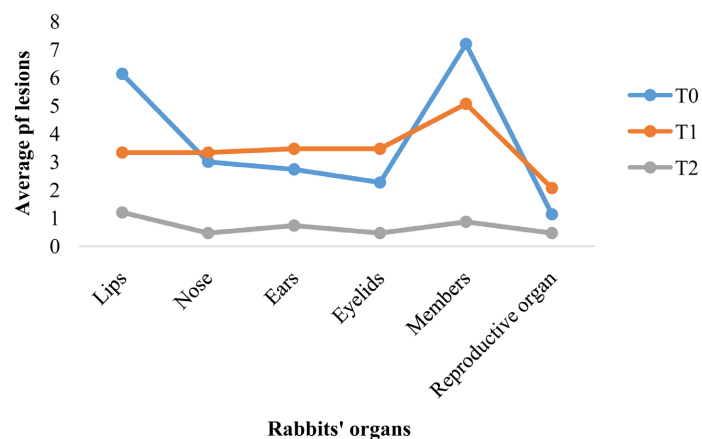


Figure 3. Evolution of lesions on the organs of rabbits in function of the application of the palmist oil + kerosene, ivermectin and rinsing with KMnO_4 .

3.5. Level of Healing of Mange Lesions Due to the Application Rate of the Palmist Oil + Kerosene, Ivermectin and Rinsing with KMnO_4

The results in **Figure 4** show the rate of healing and mortality due to the application of the palmist oil solution combined with kerosene. Indeed, all the untreated rabbits (100%) had died from the abundance of lesions on different parts of their bodies while 60% of the rabbits treated one time per day was healed and 40% had died. Finally, 90% of the rabbits receiving two treatments per day were healed and only 10% died due to the abundance of lesions on different body parts.

4. Discussion

4.1. Farmers' Perception of Rabbit Diseases in the Study Area

Rabbit farming is practiced by more women than men, in farms with an average of 10 rabbits and an experience of 26 months (2 years and 2 months) in rabbit farming. In addition, crop and livestock production are the main activities of the farmers in our study area, and the raising of large livestock is not frequently practiced (**Table 1**). Results from [19] found that the largest number of rabbit farmers in Kenya has an average experience of less than 3 years and these are similar to ours. The low experience of rabbit farming in our study area can be due to the fact that the farming of small animals such as rabbits and guinea pigs has long been neglected and misjudged by rural communities. It was only after the extension of the socio-economic and nutritional benefits of these animals that rural communities adopted them. In addition, the results of [17] show that gender is not a factor that affects rabbit production in the smallholder farming system, but our results show a high participation of women and youth in rabbit farming in our study area. This high proportion is explained by the high quality of rabbit meat and the increasing demand for rabbit meat for the commercialization of women, as they are the household managers in the rural areas. Our results are similar to those found by [32].

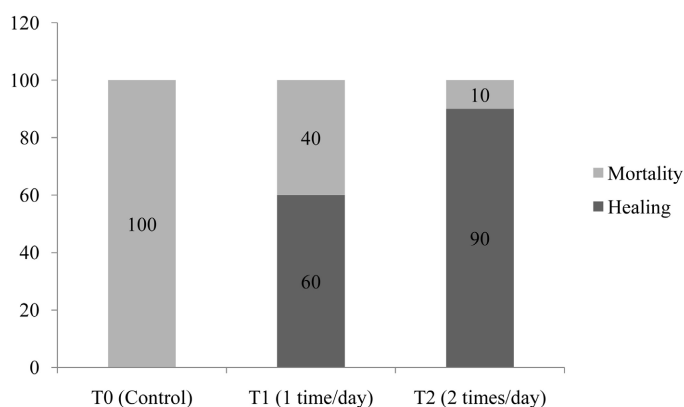


Figure 4. Level of healing of mange lesions due to the application rate of the palmist oil + kerosene, ivermectin and rinsing with KMnO_4 .

Table 1. Socio-demographic characteristics of rabbits' farmers.

Parameters	Average and frequency
<i>Gender</i>	
Man	30
Woman	70
<i>Age (year)</i>	
Experience (month)	26
Livestock size (number)	10
<i>Education level</i>	
None educational (%)	0
Primary (%)	0
Secondary (%)	85
Post secondary (%)	15
<i>Main activity</i>	
Livestock (%)	50
Salarial (%)	10
Trade (%)	15
Agriculture (%)	25
<i>Animal species</i>	
Rabbit (%)	80
Birds (%)	20
Goat (%)	0

According to [13] [14] and [33], the lack of large livestock in Kalehe and other Kivu's highlands region can be due to the fact that large livestock are the causes of spatial competition between humans and animals, that they are very demanding in terms of livestock management practices, and that large livestock are frequently the object of pillage and used as arms of war in conflict and post-conflict areas. Also, the scarcity of pasture areas due to poor access to land is also one of the causes of the discontinuation of large livestock farming in preference to small livestock farming [34] such as rabbits and other small animals. The main mode of the ectoparasites identification in the rabbit is the appearance of the clinical signs and these appear mostly on the head regions. In addition, farmers in our study area show that inappropriate livestock practices, lack of information on rabbit production, and non-use of veterinary materials are the causes of the high frequency of rabbit diseases in the study area (Table 2). Our results are similar to those of [35], who showed that lack of information on livestock production as well as poor livestock management conditions are among the causes of the frequency of pathological risks in rabbit farming.

Table 2. Technical and health characteristics of livestock in the study area.

Parameters	Frequency
<i>Rabbit and other animal species association</i>	
Yes (%)	30
No (%)	70
<i>Type of diseases</i>	
Mange (%)	75
Head lice (%)	0
Chips (%)	5
Mycosis (%)	0
None (%)	20
<i>Identification method of ectoparasite</i>	
Clinical signs (%)	80
Mortality (%)	20
<i>Organ affected by disease</i>	
Head region (%)	75
Trunk region (%)	5
Other members (%)	20
<i>Origin of rabbits' diseases</i>	
Inappropriate livestock practice (%)	50
Lack information for rabbit production (%)	20
Non utilization of veterinary input (%)	30
<i>Application of veterinary input</i>	
Yes (%)	50
No (%)	50
<i>Veteranaty input used</i>	
Ivermectin + KMnO ₄ (%)	30
Multi-vitamine (%)	10
Palmist oil + Kerosene (%)	60

Legend: KMO₄: Permaganate of Potassium.

Our results show that 50% of the rabbit farmers use veterinary products to control rabbit ectoparasites. Ivermectin and palmist oil combined with kerosene are both among the main products more used to control ectoparasites (**Table 2**). Our observations are similar to those obtained in Kenya by [24], in India by [36] and in Romania by [37] in demonstrating that ivermectin is the most used injection product on the rabbit ectoparasite control. Then results from [6] show that

the combination of palmist oil with kerosene is also used as ectoparasite treatment in the guinea pig farming. Farmers in our study area use a traditional method of control ectoparasites in their farms. [16] had shown that diseases in rabbit farming is one of the main constraints for their production, but the major part of small scale farmers use traditional methods to control ectoparasites as it is the case in our study area.

4.2. Effect of the Application Frequency of the Palmist Oil and Kerosene Combined on the Ectoparasites

The results show that the frequency of application of the palmist oil solution combined with kerosene affect significantly ($p = 0.000$) the presence of lesions on the rabbits' organs studied (Table 3). On the other hand, the progression of the lesions was a function of the application frequency of the solution (Figure 3), which influenced the mortality or healing of the rabbits treated with the application of palmist oil combined with kerosene solution (Figure 4). Our results are similar to those obtained on guinea pigs by [6] in demonstrating that the management of disease animals with the combination of palmist oil and kerosene solution has effects on the reduction of ectoparasites especially in infested farms where the farming system remains traditional. The results of [36] are similar in showing that treatment of rabbits with a single injectable dose of Ivermectin completely eliminates *Sarcoptes scabiei* on rabbits. However, [38] [39] demonstrated that good practice in disease management is one of the key factors in rabbit production since diseases are one of the major problems limiting the development of rabbit farming. According to [35], the best rabbit management depends on an adequate rabbit vaccination program as well as good sanitation in the rabbit house since the livestock farming environment is also one of the propagators of transmissible diseases in rabbits.

Table 3. Effectiveness of the products application on the presence of rabbit lesions.

Application	Lips	Nose	Ears	Eyelids	Members	Reproductive organ
T0	3	6.13	2.73	2.27	7.2	1.13
T1	3.33	3.33	3.47	3.47	5.07	2.07
T2	0.47	1.2	0.73	0.47	0.87	0.47
GA	2.27	3.56	2.31	2.07	4.38	1.22
p-value	0.017	0.003	0.049	0.049	<0.001	0.071 ^{ns}
LSD	2.106	2.709	2.244	2.397	2.802	1.366
CV	126.1	103.4	131.8	157.4	86.8	151.7

Legend: T0: control (zero application of palmist oil + kerosene solution); T1: one application per day of the solution; T2: two application per day of the solution; GA: General average; LSD: Least Significant Difference; CV: coefficient of variance.

5. Conclusion

The aim of this study was to assess the perception of farmers on the pathological problems in rabbit farming in the study area and to assess the application frequency of a veterinary therapy trial and its effects against ectoparasites in rabbits in the study area. Socio-demographic and disease management data were collected from the 100 farmers in the study area. In addition, an application of the palmist oil and kerosene combination was applied to rabbits with clinical signs of diseases in a Randomized Complete Block Design with the application frequency of the product as the only factor studied. Results show that rabbit farming is mostly practiced by women (70%) with an average age of 28 years and an average experience of 26 months (2 years and 2 months) in rabbit farming and are mostly of the secondary school level (85%). Moreover, ear mange is the most frequent disease in rabbit farming in Kalehe (75%) and the head region is the most affected by the disease (75%). The presence of symptoms is the main mode of identification of diseases (80%) and the major parts of the farmers use local products (palmist oil + kerosene) to limit the damage to the rabbits (60%). Test results on the application rate of the palmist oil solution combined with kerosene showed that the occurrence of lesions on the organs varied significantly with the application rate of the solution ($p = 0.000$). The palmist oil + kerosene solution applied two times per day (T2) reduced the lesions compared to the control with no application (T0) and reduced the risk of mortality by 90% compared to the control with 100% mortality rate. The study recommends that small-scale rabbits' farmers be supported by an extension service through the availability of good information and sanitary livestock management to improve livestock productivity.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Mugumaarhahama, Y., Mutwedu, V., Kazamwali, L., Ciza, A., Bantuzeko, F., Ndjardi, S., Ndeko, A., Cizungu, N., Azine, P. and Ayagirwe, R. (2020) Typology of Smallholder's Pig Production Systems in South Kivu, Democratic Republic of Congo: Challenges and Opportunities. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, **121**, 135-146.
- [2] Mutwedu, V., Nyongesa, A., Azine, P., Chiregeza, D., Ngoumtsop, V., Mugumaarhahama, Y. and Ayagirwe, R. (2021) Growth Performance and Reproductive Function Impairment of Based Herbicide in Male Guinea Pig (*Cavia porcellus*). *Veterinary Medicine and Science*, **7**, 1047-1055. <https://doi.org/10.1002/vms3.443>
- [3] Mutwedu, V., Ayagirwe, R., Mètre, T., Mugumaarhahama, Y., Sadiki, J. and Bisimwa, E. (2015) Rabbit Production System under Smallholder Conditions in South Kivu, Eastern DRC. *Livestock Research for Rural Development*, **27**, Article No. 206.
- [4] Cherwon, A., Wanyoike, M. and Gachui, C. (2020) Rabbit Production Practices in Kiambu County, Kenya. *International Journal of Livestock Production*, **11**, 114-121. <https://doi.org/10.5897/IJLP2020.0719>

- [5] Izquierdo, A., Garcia, J. and Romero, F. (2021) Type and Characterization of Rabbit Farmers in Mexico's Central States. *Revista Mexicana de Ciencias Pecuarias*, **12**, 469-486. <https://doi.org/10.22319/rmcp.v12i2.5811>
- [6] Cishesa, T., Mituga, V., Lutwamuzire, D., Bacishoga, S., Mètre, T. and Sanvura, V.P. (2015) Characterization of Ectoparasitosis for Guinea-Pigs Breeding and Test of Care with Palmist Oil Associated with Kerosene in Walungu Area/Sud-Kivu in the D.R. Congo. *International Journal of Innovation and Scientific Research*, **14**, 70-82.
- [7] Simtowe, F., Birthe, P., Wimba, B., Bacigale, S., Chiuri, W. and Maass, B. (2017) Determinants of Participation in Cavy Marketing Evidence from the Democratic Republic of Congo. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, **118**, 245-257.
- [8] Ayagirwe, R., Meutchieye, F., Mugumaarhahama, Y., Mutwedu, V., Baenyi, P. and Manjeli, Y. (2019) Phenotypic Variability and Typology of Cavy (*Cavia porcellus*) Production in the Democratic Republic of Congo (DRC). *Genetics and Biodiversity Journal*, **3**, 11-23. <https://doi.org/10.46325/gabj.v3i1.46>
- [9] Kouadio, K., Yao, A., Ayagirwe, R., Yéo, J., Soro, R. and Fantodji, A. (2020) Characterization of Cavy (*Cavia porcellus* L., 1875) Breeding System in Three Agroecological Zones of Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, **14**, 523-527. <https://doi.org/10.4314/ijbcs.v14i2.17>
- [10] Mugumaarhahama, Y., Ayagirwe, R., Mutwedu, V., Sadiki, J., Baenyi, P., Ciza, A. and Bisimwa, E. (2016) Local Chicken Production System Assessment in Two Agro-Ecological Zones of South-Kivu (Democratic Republic of Congo). *Livestock Research for Rural Development*, **28**, Article No. 7.
- [11] Bwihangane, B. (2018) Chicken Farming (*Gallus domesticus*) in South-Kivu, Eastern DRC. Editions Universitaires Européennes, Saarbrücken, 41 p. https://www.researchgate.net/publication/325828351_Elevage_des_poules_Gallus_d_omesticus_au_Sud-Kivu_Est_de_la_RDC
- [12] Katunga, D., Balemirwe, F., Masheka, F. and Zamukulu, P. (2020) Production Systems and Contribution on Characterization of Local Chickens in Smallholder Farmer in Sud-Kivu Province, Democratic Republic of the Congo (DRC). *Open Access Library Journal*, **7**, 1-12. <https://doi.org/10.4236/oalib.1106171>
- [13] Zamukulu, P., Ayagirwe, R., Ndeko, A., Bagula, E., Mondo, J., Ganza, D., Katunga, D. and Mushagalusa, G. (2019) Constraints and Opportunities of Crop-Livestock Integration System at Mushinga in the Eastern DR Congo. *Journal of Animal & Plant Sciences*, **41**, 7000-7014. <https://doi.org/10.35759/JAnmPlSci.v41-3.4>
- [14] Maass, B., Katunga, D., Wanjiku, C., Gassner, A. and Peters, M. (2012) Challenges and Opportunities for Smallholder Livestock Production in Post-Conflict South Kivu, Eastern DR Congo. *Tropical Animal Health and Production*, **44**, 1221-1232. <https://doi.org/10.1007/s11250-011-0061-5>
- [15] Odinwa, A., Emah, G. and Odinwa, N. (2016) Challenges of Rabbit Farming in Ogbu/Egbema/Ndoni Local Government Area of Rivers State. *International Journal of Agriculture and Earth Science*, **2**, 6-13. <https://doi.org/10.12816/0019683>
- [16] Gono, R., Dube, J., Sichewo, P. and Muzondiwa, J. (2013) Constraints and Opportunities to Rabbit Production in Zimbabwe: A Case Study of the Midlands Province, Zimbabwe. *International Journal of Science and Research*, **2**, 365-369.
- [17] Tembachako, D. and Mrema, M. (2016) Factors Affecting the Production of Rabbits by Small Holder Farmers in Mt Darwin District of Zimbabwe. *Amity Journal of Agribusiness*, **1**, 7-21.
- [18] Mutsami, C. and Karl, S. (2020) Commercial Rabbit Farming and Poverty in Urban

- and Peri-Urban Kenya. *Frontiers in Veterinary Science*, **7**, Article No. 353. <https://doi.org/10.3389/fvets.2020.00353>
- [19] Kale, P., Kitilit, J. and Kebeney, S. (2016) Rabbit Production Practices among Smallholder Farmers in Kenya. *RUFORUM Working Document Series*, **14**, 803-809.
- [20] Zamukulu, P., Njukwe, E., Bagula, E., Ayagirwe, R., Jumaine, R., Dontsop, P.-M. and Mushagalusa, G. (2016) Effects of Fertilizer on the Cassava and Common Bean Intercropped Yield in the Walungu Territory, Eastern DR Congo. *Pan-African Grain Legume & World Cowpea Conference*, Livingstone, 28 February-4 March 2016, 1 p. https://www.researchgate.net/publication/333866926_Effets_des_Fertilisants_sur_les_Rendements_du_Manioc_et_Haricot_en_Association_dans_le_territoire_de_Walungu_a_l'Est_de_la_RDC
- [21] Upenji, R., Umirambe, E., Lobo, E., Abineno, E., Zamukulu, P., Mushagalusa, P. and Katunga, D. (2020) Improve Common Bean (*Phaseolus vulgaris* L.) Yield through Cattle Manure in Nioka Region, Ituri Province, DRC. *Open Access Library Journal*, **7**, e6610. <https://doi.org/10.4236/oalib.1106610>
- [22] Kavange, A., Cishesa, T., Zamukulu, P., Kulimushi, J. and Ganza, D. (2018) Effect of Plant Spacing and Organic Fertilizer on Irish Potatoes Yield (*Solanum tuberosum* L.) at Walungu, Eastern DR Congo. *Afrique Science*, **14**, 316-322.
- [23] Ogolla, K., Chebet, J., Gathumbi, P., Waruiru, R., Okumu, P., Munyua, W., Kitala, P., Gichure, J., Wanyoike, M., Mailu, S., Kibebe, H. and Hungu, J. (2017) Farmer Practices That Influence Risk Factors, Prevalence and Control Strategies of Rabbit Coccidiosis in Central Kenya. *Livestock Research for Rural Development*, **29**, Article No. 134.
- [24] Ogolla, K., Chebet, J., Waruiru, R., Gathumbi, P., Okumu, P. and Aboge, G. (2019) Efficacy of Ivermectin, Liquid Paraffin, and Carbaryl against Mange of Farmed Rabbits in Central Kenya. *Journal of Tropical Medicine*, **2019**, Article ID: 5092845. <https://doi.org/10.1155/2019/5092845>
- [25] Bantuzeko, F., Ciza, A., Barume, C., Mugumaarhahama, Y. and Amzati, G. (2022) Farmers' Perceptions on Technical Controls and Risk Factors of East Coast Fever Caused by *Theileria parva* in Mountainous Kivu, Democratic Republic of Congo. *Journal of Animal & Plant Sciences*, **51**, 9213-9226.
- [26] Bisimwa, P., Dione, M., Basengere, E., Ciza, A., Steinaa, L. and Ongus, J. (2021) Risk Factors of African Swine Fever Virus in Suspected Infected Pigs in Smallholder Farming Systems in South-Kivu Province, Democratic Republic of Congo. *Journal of Veterinary Science*, **22**, e35. <https://doi.org/10.4142/jvs.2021.22.e35>
- [27] Cishesa, T., Kavange, A., Kulimushi, J., Rugendabanga, D., Ndagano, C., Lufungulo, R., Bahavu, C., Nshokano, J. and Zamukulu, P. (2022) Traditional Livestock System and Pathologies Risk in the Small-Scale Pig Farming in Kamituga Sub County, Eastern Democratic Republic of Congo. *Open Access Library Journal*, **9**, e8637. <https://doi.org/10.4236/oalib.1108637>
- [28] Ciza, A., Etter, E. and Penrith, M.-L. (2021) Review of African Swine Fever Outbreaks History in South Africa: From 1926 to 2018. *Onderstepoort Journal of Veterinary Research*, **88**, e1-e10. <https://doi.org/10.4102/ojvr.v88i1.1919>
- [29] Hajipour, N. and Zavarshani, M. (2020) Ectoparasites and Endoparasites of New Zealand White Rabbits from North West of Iran. *Iranian Journal of Parasitology*, **15**, 266-271. <https://doi.org/10.18502/ijpa.v15i2.3310>
- [30] Napoli, E., Remesar, S., Gaglio, G., Giannetto, S., Spadola, F., Díaz, P., Morrondo, P. and Brianti, E. (2021) Ectoparasites of Wild Rabbit (*Oryctolagus cuniculus*) in Southern Italy. *Veterinary Parasitology: Regional Studies and Reports*, **24**, Article

ID: 100555. <https://doi.org/10.1016/j.vprsr.2021.100555>

- [31] Faida, G. (2020) Impact of Small Scale Mining on the Environment Degradation in Kalehe, DR Congo, M.Sc. Thesis, UEA, Bukavu, 39 p.
- [32] Fortun-Lamothe, L., Combes, S. and Gidenne, T. (2009) Contribution of Intensive Rabbit Breeding to Sustainable Development. A Semi-Quantitative Analysis of the Production in France. *World Rabbit Science*, **17**, 79-85. <https://doi.org/10.4995/wrs.2009.661>
- [33] Katunga, D. and Muhigwa, J.-B. (2014) Assessing Post-Conflict Challenges and Opportunities of the Animal-Agriculture System in the Alpine Region of Uvira District in Sud-Kivu Province, D.R. Congo. *American Journal of Plant Sciences*, **5**, 2948-2955. <https://doi.org/10.4236/ajps.2014.520311>
- [34] Bacigale, S., Birthe, P., Muhimuzi, F., Mapenzi, N., Peters, M. and Maass, B. (2014) Characterizing Feeds and Feed Availability in Sud-Kivu Province, DR Congo. *Tropical Grasslands—Forrajes Tropicales*, **2**, 9-11.
- [35] Abubakar, S. and Bello, A. (2020) Rabbit Production in Semi Arid Zone of Sokoto State. *American Journal of Biomedical Science & Research*, **7**, 224-232. <https://doi.org/10.34297/AJBSR.2020.07.001147>
- [36] Sharun, K., Anjana, S. and Aboobacker, S. (2019) Treatment of Sarcoptic Mange Infestation in Rabbits with Long Acting Injectable Ivermectin. *Journal of Parasitic Diseases*, **43**, 733-736. <https://doi.org/10.1007/s12639-019-01137-z>
- [37] Deak, G. and Turcu, C. (2020) A Case of Infestation with *Leporacarus gibbus* in a Pet Rabbit. *Scientia Parasitologica*, **21**, 138-141.
- [38] Chah, J., Attamah, C. and Nnodim, E. (2018) Disease Management Practices among Rabbit Farmers in Enugu State Nigeria. *Journal of Agricultural Extension*, **22**, 130-138. <https://doi.org/10.4314/jae.v22i3.13>
- [39] Espinoza, J., Ferreras, C., Benavides, J., Cuesta, N., Pérez, C., Iglesias, J., Marin, F. and Pérez, V. (2020) Causes of Mortality and Disease in Rabbits and Hares: A Retrospective Study. *Animals (Basel)*, **10**, 1-17. <https://doi.org/10.3390/ani10010158>