# Status and Constraints in Farming of Domesticated Rabbits in Western and North Rift Kenya

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**Abstract**

*Rabbit farming is recognised as an important enterprise. Domestic rabbits are raised mainly for meat in major parts of the world. Domesticated rabbit farming in Africa has a challenge of low meat production and mostly done by resource poor and low-income farmers. The study covered the Western and North Rift regions of Kenya using exploratory research design to generate the required information targeting 112 rabbit farmers. The study used both stratified and systematic sampling basing on different Agro Ecological Zones. Farmers were obtained through snow balling technique using structured questionnaires. Data collected was analysed using SPSS (version 20). Majority of the respondents (56.3%) were males aged below 36 years (96.4%) and had formal education. Main breeds for meat were New Zealand White 48 (43.6%) and Flemish giant 22 (20.0%), while palomino was least kept with a statistically significant difference ($\chi^2$ = 84.24, d.f.=6, p<0.0001). Most rabbits were reared in cages 90(86.5%) (p< 0.0001) measuring 1.5m by 1.5m (68.3%) raised about a metre high serving as anti-predation tactics. Breeding stock were sourced from fellow farmers (85.5%). Rabbits aged three months were sold at an average price of Ksh.200 while those over five at 1200. A large proportion of farmers indicated they never cleaned rabbit houses 57 (50.9%). Main rabbit feed was vegetables from farms 68(60.7% rarely supplemented with Pellets 23(76.7%). Rabbits encountered diarrhoea and skin diseases 12(10.7%), predators 68(60.7%), thieves 14(14.3%), sudden deaths, and high costs of building materials with a significant difference ($\chi^2$ = 121.818 with 4 d.f. P-Value = 0.0001) Rearing practices and challenges differed from each. The study concluded that more awareness be created on the need to keep rabbits for income. Research and training on rabbit management and marketing is needed to support the growth of rabbitry in the regions.*

**Keywords:** Domesticated Rabbit, Constraints, Farming

## INTRODUCTION

The commonly known rabbit (*Oryctolagus cuniculus*) is a European breed that is well known worldly both domestically as well as in the wild. Its domesticated relative shows exceptional phenotypical variations, morphometric as well as prolificacy (Flisikowska, Kind & Schnieke, 2014. The domesticated Scandinavian and the wild rabbit originated from a species *Oryctolagus cuniculus* which is typical to the genus *Oryctolagus* belong to the single species *Oryctolagus cuniculus* which is typical to the genus *Oryctolagus* (Branco, Ferrand & Monnerot, 2000). The O. *cuniculus*, considered the single recognized ancestor of domestic rabbits. It is reported that the *O. c. cuniculus* appears to be the only direct source of all domestic rabbits, based on the fact that there is no empirical evidence to refute this assertion. The result of change in morphological

characteristics, physiology, behaviour as well as reproduction has been brought about due to its domestication (Carneiro *et al.*, 2014).

Karikari & Asare, (2009) reported the recognition of the potentiality of rabbit farming as an industry. In Europe and the United States of America, the practice has been going on for quite a number of years. In major parts of the world, domesticated rabbits are mainly raising for meat (Payne and Wilson, 1999). Meat produced from rabbits is regarded as the most nutritious as compared to other sources of animal protein. Cullere & Dalle Zotte, (2018) acknowledges that domestic rabbit meat has high protein and low fat thus possessing health promoting qualities. The potential of domestic rabbit in supplying meat for world's protein needs has been reported by Cullere & Dalle Zotte (2018). In some instances, they provide manure, fur, skins, and wool (Abd El-Ghany, 2020; Somerville & Sugiyama, 2021).

In developing world, increase in human population has led to farms being smaller and smaller and these farms are feed sources. (Crist, Mora & Engelman, 2017). The enterprise is being commercialised in the rural and the urban areas in Africa. Domesticated rabbits farming in Africa is mostly done by resource poor and low-income farmers. In Egypt and Nigeria, the enterprise has increased the number from home consumtion to being commercialised. Major participants in rabbit production in Africa include Nigeria, Ghana, Zambia and Togo (Oseni & Lukefahr, 2014). Kenya has far below supply of recommended FAO protein per capita of 16.34 kg of red meat supply (FAOSTAT, 2007) which makes domestic rabbit farming viable option of meat (Cullere and Dalle Zotte, 2018).

The commonly bred rabbits in Kenya include: the crosses of Chinchilla, New Zealand White, Flemish giant, Angora, Kenya White (Chebet, Waruiru & Ogolla, 2018) which are known to produce tasty meat for domestic consumption (Ogolla et al., 2017). In Agriculture, the major profit in rabbit farming mainly depends on good managerial practices as well as maketing strategies (Pascaris et al., 2021). In Kenya, fewer adult farmers in comparison to youths are interested in rabbit production and consumption when compared to other livestock sub-sectors thought the trend is changing (Cherwon, Wanyoike & Gachuiri, 2020). Rabbit rearing is not expensive as they can be fed from vegetables grown in the surrounding areas (Serem et al., 2013). As in all facets of agriculture, the profits from rabbit farming depend a great deal on management and market opportunities (Hungu et al., 2011; Mfuko, 2017)). Even with the increasing interest and benefits from rabbit rearing, the industry is faced with several challenges such as diseases. Housing, space, regular sanitation and proper feeding determines how successful the project can be (Hungu et al., 2011). Kenya is a third world country having a largedeveloping country with a large population residing in the rural areas, and who are engaged in agricultural production as a major means of livelihood. The Kenyan Government as well as Non-Governmental Organizations (NGOs) are encouraging small income generating projects for the rural farmers by funding and providing technical knowhow on how to implement such projects. Rabbit production is also limited by inadequate availability of parent breeding stock, high cost of commercial feeds and limited access by farmers to technical information (Cherwon, Wanyoike & Gachuiri, 2020; Wambugu, 2015).

More research on rabbit production is still required to offer current information to rabbit producers so as to expand its productivity. The current study intended to come up with important technical information for makers of policies on status and production characteristics and constraints hindering production and marketing of both rabbits and its products in Kenyan backcountry and its interior. Kenya, if attended to would enhance incomes of the rural communities that would lead to poverty alleviation as well as food security enhancement.

## METHODOLOGY

### Area of Research

The study covered the Western and North Rift regions of Kenya which is comprised of counties of Bungoma, Busia, Kakamega, Vihiga (Western region), Elgeiyo -Marakwet, Nandi, Trans-Nzoia and Baringo (North Rift region) (Fig. 1.)

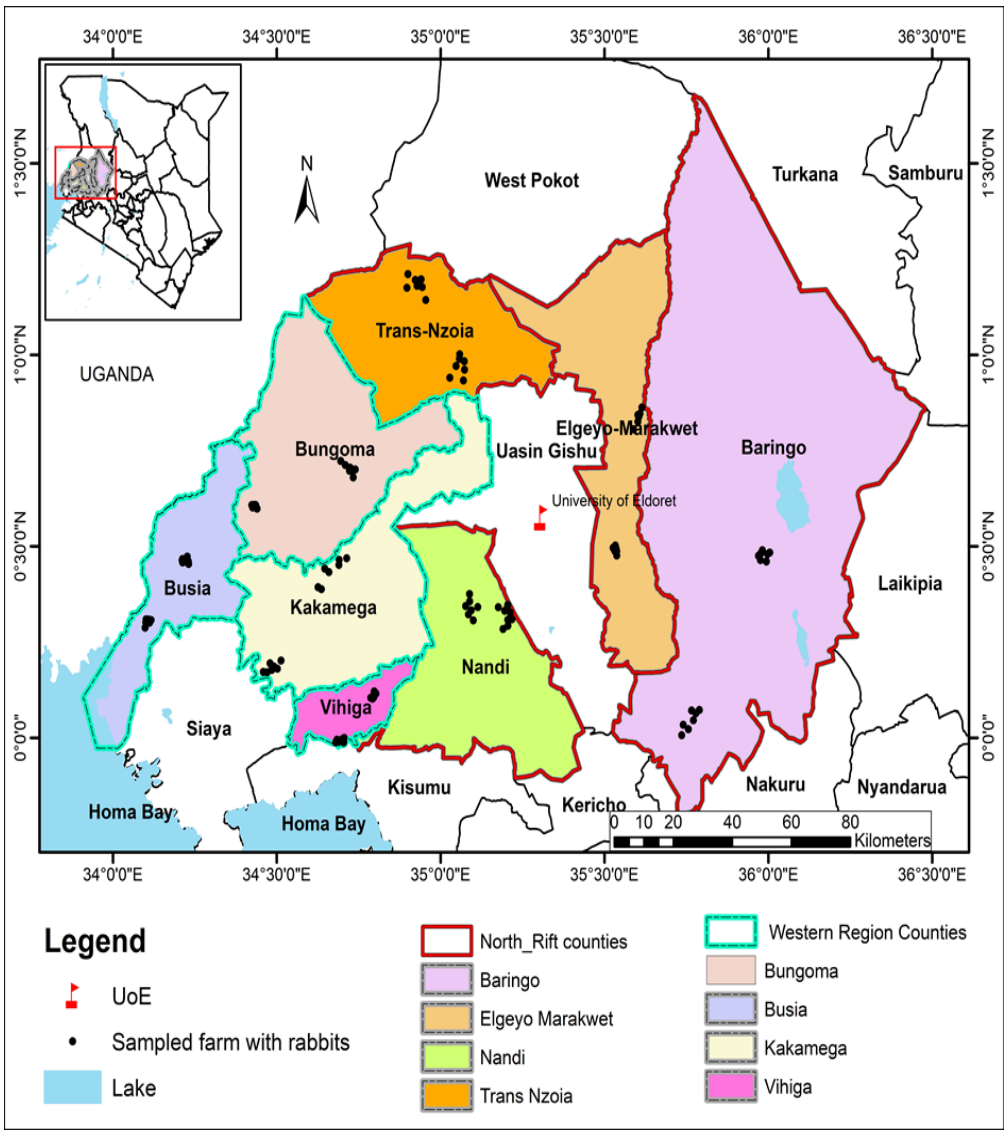


**Figure 1: Map of the study area**

### Investigative technique

Information-gathering in this research used exploratory design for the generation of required information. Stebbins (2001) acknowledged the use of exploratory design in that it allows the investigator to perform an all-inclusive inference on the researched variables in the population that was targeted.

**Sampling procedures and sample selection**

The study targeted 112 rabbit farmers who comprised 56 from Western and the other 56 farmers from North Rift region of Kenya. Study used both stratified and systematic sampling where population was divided into clusters (Western and North Rift regions) before sampling. The regions were chosen because of their different agro-climatological zones which were assumed to determine the phenotype of the rabbit breeds in the country. The counties in the said regions were Nandi, Elgeyo Market, Baringo and Trans Nzoia in the North Rift region and the Western region counties based on Kenyan Administrative units were: Vihiga, Kakamega, Bungoma and Busia. The regions were then subdivided into smaller clusters in which seven farmers rearing rabbits were obtained through snow balling technique which involved identifying a farmer from another. Through this method of referrals in succession all farmers with rabbits were reached. Sample targeted and reached in this investigation was 112 rabbit farmers.

**Collection of data**

Collection of primary and secondary data was done using structured questionnaires having open and closed questions and administered to the local rabbit farmers in the two regions by the researcher. Secondary data collection involved gathering data from sources which had already been documented by other researchers concerning rabbit farming in the said regions.

**Analysis of data and technique presentations**

Data collected was analysed with the help of statistical Package for Social Science (SPSS version 20). Data collected through questionnaires was coded, analysed and relationships between variables derived using cross-tabulation. Results were presented using tables, graphs and qualitative statements and descriptions. Descriptive statistics were used to determine frequencies and percentages while inferential statistical analysis using the chi-square test to determine whether expected frequencies differ from the actual frequencies.

## RESULTS

**Characteristics appertaining to the respondents**

Results based on questionnaire and interview responses are presented in this chapter. The analysis of results and exploring of the relationships between and among variables was done using descriptive statistics, cross tabular analysis and chi square tests.

There were one hundred and twelve (112) questionnaires administered to the local residents who kept and reared rabbits from North Rift and Western Provinces of Kenya Male respondents were the majority comprising (56.3%). Those aged below 36 years were of a large population and comprised 52.7% and those above 36 years comprised 47.3%. Majority of the respondents had formal education (96.4%) with 54.5% which owned certificate of secondary education (table 1). Unemployed local residents were the highest respondents (64.3%). The respondents that were residents by birth comprised (73.5%). Majority of the respondents had stayed there for18 years and above (81.3%). Majority of the respondents (82.1%) were mixed farmers while (14.3%) practised livestock rearing. Few respondents (3.6%) practiced others forms of land used such as small businesses enterprises such as quarrying as illustrated in Table 1.

**Table 1. Socio-demographic profile of the respondents**

| Variable | Respondents | Frequency (f) | Percentages (%) |
|---|---|---|---|
| Gender | Male | 52 | 46.4 |
| | Female | 60 | 53.6 |
| | Total | 112 | 100.0 |
| Age | <18 yrs. | 10 | 8.9 |
| | 18-25 yrs. | 25 | 22.3 |
| | 26-35 yrs. | 24 | 21.4 |
| | 36-45 yrs. | 27 | 24.1 |
| | 46-55 yrs. | 17 | 15.2 |
| | Above 56 yrs. | 9 | 8.0 |
| | Total | 112 | 100.0 |
| Education | None | 4 | 3.6 |
| | Primary | 28 | 25.0 |
| | Secondary | 61 | 54.5 |
| | Tertially | 12 | 10.7 |
| | University | 7 | 6.3 |
| | Total | 112 | 100.0 |
| Occupation | Employed | 9 | 8.0 |
| | Self employed | 31 | 27.7 |
| | Un employed | 72 | 64.3 |
| | Total | 112 | 100.0 |
| Residence | Birth | 97 | 86.6 |
| | Immigrant | 15 | 13.4 |
| | Total | 112 | 100.0 |
| Period of residency | <18 yrs. | 21 | 18.8 |
| | 18-25 yrs. | 35 | 31.3 |
| | > 25 yrs. | 56 | 50.0 |
| | Total | 112 | 100.0 |
| Forms of land use | Livestock keeping | 16 | 14.3 |
| | Mixed farming | 92 | 82.1 |
| | Others | 4 | 3.6 |
| | Total | 112 | 100.0 |

**Farm characteristics and rabbit production system**

The interviewed farmers who kept and reared rabbits were asked to indicate other types of livestock they kept. Majority of them had chicken (89.3%) and cattle (49.1%) while few kept sheep (10.7%) with a significant difference ($\chi^2$ = 145.15, d.f.=4, p<0.0001) as portrayed in figure 1. In Western region, majority of farmers kept chicken followed by cattle in significantly difference from farmers in North Rift region ($\chi^2$ = 20.00, d.f.=16, p=0.2202). Only 8 (15.4%) farmers agreed that rabbit farming was their main type of farming as it was a project owned by young boys in the family.

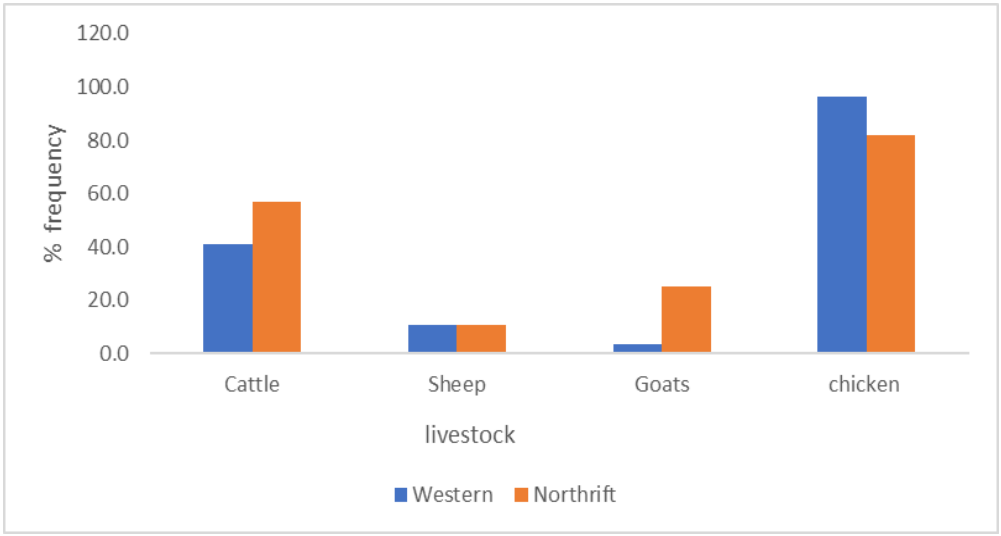


**Figure 2: Other types of livestock**

**Types of rabbits reared by farmers and reasons for having rabbits**

A large proportion of the respondents had kept rabbits for a period of less than five years 77(74.0%) while a few had done so for a period of over 10 years with a significant difference ($\chi^2$ = 28.96, d.f.=3, p<0.0001). Most farmers 62(59.6%) were not aware of the breeds' name they reared ($\chi^2$ = 4.00, d.f.=1, p= 0.0455) but distinguished them by coat and eye colours ($\chi^2$ =47.66, df=2, p< 0.0001). For those who were aware of breeds they reared, majority acknowledged rearing New Zealand White 48 (43.6%) followed by Flemish giant 22 (20.0%) while palomino was least kept with a statistically significant difference ($\chi^2$ = 84.24, d.f.=6, p<0.0001) as illustrated in table 2. In cross tabulation with education level, respondents educated upto secondary and tertiary level of education were more aware of breeds` name they reared in their farms ($\chi^2$ =54.89, df=2, p=0.0002). All respondents (100.0%) agreed with the statement that rabbit farming had a reason attached to it. Rabbits were kept for various reasons such as meat provision 40 (38.5%), as pets (31.7%), sales (21.2%) while few indicated that they kept them for skin and fur 5(4.8%) as well as for breeding purposes (6.7%) as illustrated in table 2. There was a significant difference in provided reasons as to why farmers kept and reared rabbits ($\chi^2$ = 41.85, d.f.=4, p<0.0001).

**Table 2: Types of rabbits reared by farmers and reasons for having them**

| Question | Attribute | f | % f | Chi square ($\chi^2$) |
|---|---|---|---|---|
| period in which farmers had kept rabbits | Less Than 1 Year | 33 | 31.7 | $\chi^2$= 28.96 d.f.=3 p = 0.0000 |
| | 2- 5 Years | 44 | 42.3 | |
| | 6- 10 Years | 21 | 20.2 | |
| | Over 10 Years | 6 | 5.8 | |
| | Total | 104 | 100.0 | |
| Do you know the breed you keep? | Yes | 42 | 40.4 | $\chi^2$= 4.0 d.f.=1 p = 0.0455 |
| | No | 62 | 59.6 | |
| | Total | 104 | 100.0 | |
| if no, how do you distinguish them | Eye Colour | 11 | 10.6 | $\chi^2$= 47.66 d.f.=2 p= 0.0000 |
| | Coat Colour | 25 | 24.0 | |
| | Both | 68 | 65.4 | |
| | Total | 104 | 100.0 | |
| if yes, which breed (name) | New Zealand White | 48 | 43.6 | $\chi^2$= 84.24 d.f.=6 p = 0.0000 |
| | Chinchilla | 3 | 2.7 | |
| | Dutch | 10 | 9.1 | |
| | Rex | 7 | 6.4 | |
| | Silver fox | 8 | 7.3 | |
| | Agouti | 12 | 10.9 | |
| | Flemish Giant | 22 | 20.0 | |
| | Total | 110 | 100.0 | |
| Why do you keep rabbits? | Pets | 30 | 28.8 | $\chi^2$= 41.85 d.f.=4 p = 0.0000 |
| | Meat | 40 | 38.5 | |
| | Skins And Fur | 5 | 4.8 | |
| | Breeding Purposes | 7 | 6.7 | |
| | Sales | 22 | 21.2 | |
| | Total | 104 | 100.0 | |

**Rabbit housing**

The proportion of respondents who at least indicated they reared their rabbits in cages 90(86.5%) was high ($\chi^2$ = 205.29, d.f.=3, p< 0.0001) as compared to those who reared in an indoor rabbitry 10(9.6%) free range 2 (1.9%) and both 2(1.9%). The measurement of the rabbit house was 1.5m by 1.5m and above (68.3%) with statistically significant difference ($\chi^2$ = 2.24, d.f.=2, p = 0.3263). Majority of the structures were raised (99.0%) about a metre from the ground ($\chi^2$ = 96.04, d.f.=1, p< 0.0001) as anti-predation tactics (50.3%) against dogs and mongooses ($\chi^2$ = 44.24, d.f.=1, p<0.0001). The number of rabbits housed per structure had an average ranging from 10 and above 26(50.0%) with the highest record of 200 individual rabbits in one enclosure ($\chi^2$ = 14.66, d.f.=2, p= 0.0005) as illustrated in table 3.

**Table 3: Rabbit housing**

| Question | Attribute | f | % f | Chi square ($\chi^2$) |
|---|---|---|---|---|
| Which type of structure do you house your rabbits in? | Rabbit cage | 90 | 86.5 | $\chi^2$= 205.28 d.f.=3 p= 0.0000 |
| | Indoor rabbitry | 10 | 9.6 | |
| | Free range | 2 | 1.9 | |
| | Both | 2 | 1.9 | |
| | Total | 104 | 100.0 | |
| Approximate size of the rabbit house/. Structure | 1m by 1m | 33 | 31.7 | $\chi^2$= 2.24 d.f.=2 p = 0.3263 |
| | 1.5m by 1.5 m | 29 | 27.9 | |
| | Over 1.5m by 1.5m | 42 | 40.4 | |
| | Total | 104 | 100.0 | |
| Nature | Raised | 103 | 99.0 | $\chi^2$= 96.04 d.f.=1 p= 0.0000 |
| | Unraised | 1 | 1.0 | |
| | Total | 104 | 100.0 | |
| If raised, reasons | Against predation | 79 | 50.3 | $\chi^2$= 44.24 d.f.=2 p = 0.0000 |
| | For hygiene purposes | 75 | 47.8 | |
| | None | 3 | 1.9 | |
| | Total | 157 | 100.0 | |
| Number of rabbits per structure | 1 per structure | 20 | 19.2 | $\chi^2$= 14.66 d.f.=2 p= 0.0007 |
| | 2-10 per structure | 32 | 30.8 | |
| | 10 and above | 52 | 50.0 | |
| | Total | 104 | 100.0 | |

**Source of rabbit breed**

Most farmers (85.5%) indicated that they sourced breeding stocks from Local farmers/ breeders ($\chi^2$ =125.78, df=2, p< 0.0001) with emphasis focusing on size and beauty of the breed 57 (56.4%) and advice from farmers 25(24.8%) with a statistically significant difference ($\chi^2$ =23.66, d.f.=2, p<0.0001) as illustrated in table 3. Majority of farmers (46.8%) indicated that they provided six females to one male for breeding purposes ($\chi^2$ =36.44, df=3, p<0.001) with a significant difference between the regions. Insignificant ($\chi^2$= 0.82, d.f.=1, p=0.3652) large proportion of respondents 61(54.5%) indicated that they provided pregnant does with nesting boxes where approximately between 6 and 10 young ones per female rabbit doe 102(95.3%) were born with a significant difference ($\chi^2$= 171.43, d.f.=2, p<0.0001). Females were recorded to eat some of the weak young ones by majority of farmers but this did not deter many to reach market age 83(76.1%) where they were sold to individuals 109(94.8%). Majority of rabbits were sold when at an age of more than three months but less than five months 57(52.3%) as illustrated in table 4. Farmers indicated that they sold mature rabbits for a price ranging from 200 to 1200 Ksh with majority selling at an average of ksh. 200 to 500 with a significant difference from those who sold at an average of above ksh.800 ($\chi^2$ = 47.63, d.f.=3, P-Value = 0.0000).

**Table 4: Source and selection of rabbit breed stock**

| Question | Attribute | f | % f | Chi square ($\chi^2$) |
|---|---|---|---|---|
| Where do you source your rabbit stock? | Local farmers/ breeders | 100 | 85.5 | $\chi^2$= 125.78 |
| | Breeding centres | 4 | 3.4 | d.f.=2 |
| | Performance | 13 | 11.1 | p= 0.0000 |
| | total | 117 | 100.0 | |
| how rabbits were selected for breeding stock | By breed | 19 | 18.8 | $\chi^2$= 23.66 |
| | Advice from farmers | 25 | 24.8 | d.f.=2 |
| | Size and beauty | 57 | 56.4 | p= 0.0000 |
| | total | 101 | 100.0 | |
| What is the ratio of males to females | 1 female | 7 | 6.3 | $\chi^2$= 36.43 |
| | 2-5 females | 20 | 18.0 | d.f.=3 |
| | 6- 10 females | 52 | 46.8 | p= 0.0000 |
| | more than 10 females | 32 | 28.8 | |
| | total | 111 | 100.0 | |
| Do you provide nesting boxes for pregnant does? | yes | 61 | 54.5 | $\chi^2$= 0.82 |
| | no | 51 | 45.5 | d.f.=1 |
| | total | 112 | 100.0 | p=0.3652 |
| How any young ones are born per one doe? | less than 5 | 1 | 0.9 | $\chi^2$= 171.43 |
| | 6-10 young | 102 | 95.3 | d.f.=2 |
| | more than 10 young ones | 4 | 3.7 | p= 0.0000 |
| | total | 107 | 100.0 | |
| Approximate number of young ones that reach maturity of marketable age per doe? | less than 5 | 1 | 0.9 | $\chi^2$= 146.16 |
| | 6-10. | 21 | 19.3 | d.f.=3 |
| | More than 10. | 4 | 3.7 | p = 0.0000 |
| | all | 83 | 76.1 | |
| | total | 109 | 100.0 | |
| where do you sell your rabbits | to individuals farmers | 109 | 94.8 | $\chi^2$= 273.32 |
| | nearby market | 1 | 0.9 | d.f.=3 |
| | to hotels | 1 | 0.9 | p = 0.0000 |
| | none | 4 | 3.5 | |
| | total | 115 | 100.0 | |
| age at which rabbits were sold | less a month old | 6 | 5.5 | $\chi^2$= 35.12 |
| | 3- 5 months old | 57 | 52.3 | d.f.=2 |
| | above 5 months old | 46 | 42.2 | p= 0.0000 |
| | total | 109 | 100.0 | |
| cost of a mature rabbit | < 200 ksh | 5 | 4.7 | $\chi^2$= 47.63 |
| | 200-500 ksh | 55 | 51.4 | d.f.=3 |
| | 500-800 ksh | 31 | 29.0 | p= 0.0000 |
| | > 800 ksh | 16 | 15.0 | |
| | total | 107 | 100.0 | |

**Rabbit house cleaning practices**

Farmers were asked to indicate their various major supply of water to their farm. A large fraction of them indicated that they relied on dug out wells 57(52.8%) followed by those who fetched water from rivers / lakes 39(36.1%) while few relied on seasonal ponds 5(4.6%) with majority

coming from North Rift region with a significant difference ($\chi^2$ = 105.75, d.f.=4, p< 0.0001). A large proportion of farmers indicated they never cleaned rabbit houses 57 (50.9%). For those who cleaned, few did it thrice a week 5(4.5%) with majority practicing manure removal only 46 (70.8%) followed by those who sprinkled ash (*jivu*) as a disinfectant 8(12.3%) as well as adding more fresh straw 5(7.7%) with a significant difference ($\chi^2$ = 162.95, d.f.=4,p<0.0001) as shown in table 5.

**Table 5: Rabbit house cleaning practices**

| Question | Attribute | f | % f | Chi square ($\chi^2$) |
|---|---|---|---|---|
| Where do you source water into your farm? | piped water | 4 | 3.7 | $\chi^2$= 105.75 |
| | River/ lake | 39 | 36.1 | d.f.=4 |
| | Well | 57 | 52.8 | p= 0.0000 |
| | Rain water | 3 | 2.8 | |
| | Seasonal ponds | 5 | 4.6 | |
| | total | 108 | 100.0 | |
| How often is the house of your rabbits cleaned? | Daily | 16 | 14.3 | $\chi^2$= 68.5 |
| | Once a week | 25 | 22.3 | d.f.=4 |
| | Twice in a week | 9 | 8.0 | p = 0.0000 |
| | Thrice weekly | 5 | 4.5 | |
| | Never | 57 | 50.9 | |
| | total | 112 | 100.0 | |
| What regime of cleaning do you use? | Only sweeping | 3 | 4.6 | $\chi^2$= 162.95 |
| | Adding more straw | 5 | 7.7 | d.f.=4 |
| | Manure removal only | 46 | 70.8 | p= 0.0000 |
| | use of disinfectant (ash) | 8 | 12.3 | |
| | All of the above | 3 | 4.6 | |
| | total | 65 | 100.0 | |

**Rabbit feeding**

Majority of farmers never gave rabbits drinking water 92(86.8%) as they do not take it 73(68.9%) and for fear that they may die of diarrhoea 19(20.7%) with a significant difference ($\chi^2$= 29.96, d.f.=1, p<0.0001). Varieties of feeds were given to rabbits ranging from Commercial pellets to kitchen left-overs. Majority of rabbits were fed purely using vegetables plucked or uprooted from farms 68(60.7%) while others were fed with commercial pellets 30(26.8%) as well as kitchen remains 3(2.7%) with a significant difference ($\chi^2$ = 80.36, d.f.=3, p<0.0001). Commercial pellets were sourced mainly from agro vets 23(76.7%). For those who were fed with green vegetables, the vegetables were mainly collected from individual farms 61(89.7%). the vegetables were first wilted in the sun (16.4%) and fed the following day at intervals 82(74.5%) by young boys 68(60.7%) but while in school, all this was done by parents/ farmer 30(26.8%) with a significant difference ($\chi^2$ = 30.57, d.f.=2, p<0.0001). This was done to prevent diarrhoea in rabbits as respondents added. For Commercial pellet, they were sourced from nearby agro-vet (100.0%) with advice on how to feed rabbits being sourced from other local rabbit farmers as illustrated in table 6.

**Table 6: Rabbit feeding**

| Question | Attribute | f | % f | Chi square ($\chi^2$) |
|---|---|---|---|---|
| Do you give your rabbits water to drink | Yes | 14 | 13.2 | $\chi^2$= 54.76 |
| | No | 92 | 86.8 | d.f.=1 |
| | Total | 106 | 100.0 | p = 0.0000 |
| If no, why | They do not drink | 73 | 79.3 | $\chi^2$= 29.96 |
| | They will diarrhoea | 19 | 20.7 | d.f.=1 |
| | Total | 92 | 100.0 | p = 0.0000 |
| What do you feed your rabbits? | Commercial Pellets | 30 | 26.8 | $\chi^2$= 80.36 |
| | Vegetables | 68 | 60.7 | d.f.=3 |
| | Left over foods | 3 | 2.7 | p = 0.0000 |
| | All | 11 | 9.8 | |
| | Total | 112 | 100.0 | |
| If Commercial Pellets, where do you buy the? | Agro-Vet | 23 | 76.7 | $\chi^2$= 29.16 |
| | Suppliers | 7 | 23.3 | d.f. =1 |
| | Total | 30 | 100.0 | p= 0.0000 |
| If vegetables, where do you get the? | From individual as well as neighbours farm | 61 | 89.7 | $\chi^2$= 64.0 |
| | Market vendors | 7 | 10.3 | d.f.=1 |
| | Total | 68 | 100.0 | p= 0.0000 |
| Do you give your rabbits vegetables that are wet? | Yes | 11 | 16.4 | $\chi^2$= 46.24 |
| | No | 56 | 83.6 | d.f.=1 |
| | Total | 67 | 100.0 | p = 0.0000 |
| How often do you feed your rabbits per day? | Continuous / ad libitum | 28 | 25.5 | $\chi^2$= 24.02 |
| | Intervals | 82 | 74.5 | d.f.=1 |
| | Total | 110 | 100.0 | p= 0.0000 |
| Who is the caretaker of your rabbits (feeding, house cleaning)? | Farmer | 30 | 26.8 | $\chi^2$= 4.99 |
| | Employee | 14 | 12.5 | d.f.=1 |
| | Children | 68 | 60.7 | p = 0.0253 |
| | Total | 112 | 100.0 | |

**Production problems and diseases**

Rabbit farmers indicated that they encountered problems while practicing rabbitry. These problems were diseases like diarrhoea and skin diseases 12(10.7%), predators such as dogs and mongooses 68(60.7%), thieves (from other rabbit keepers) 14(14.3%), mortality of the rabbits/ sudden deaths, and high costs of building materials such as nails and iron sheets with a significant difference ($\chi^2$ = 121.818 with 4 d.f. P-Value = 0.0000) as portrayed in figure 3.

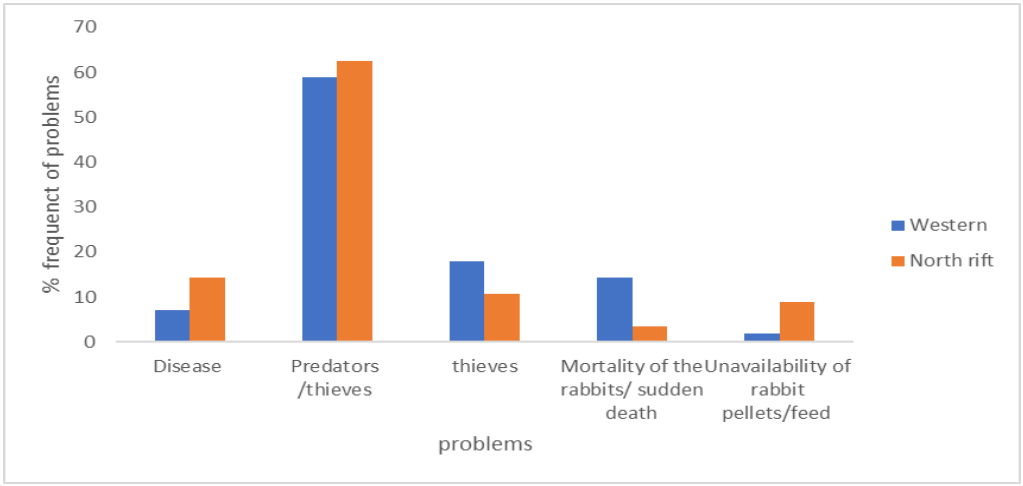


**Figure 3: Rabbit production problems and diseases**

For disease treatment, rabbit farmers sought advice from other rabbit farmers (57.5%), agro vet staff (22.0%) and both (30.5%) with a significant difference ($\chi^2$ = 19.1545 with 2 d.f. P-Value = 0.0001). Administration of drugs was done by farmers in their own premises. Not a single rabbit farmer was a member of a rabbit group organization in both regions.

## DISCUSSIONS

### Farm characteristics and rabbit production system

From this study it was discovered that the farmers reared other types of livestock which included chicken, cattle, sheep among others and indicated that rabbit farming was not their main type of farming as it was a project owned by young boys in the family. The findings are consistent with those of Chah et al. (2017) who attributed it to low demand for rabbit meat thereby discouraging farmers from large scale production. This disagrees with findings of Hungu et al. (2011) that rabbit farming in central Kenya is one of the main types of enterprise on farm because it requires less space than other types of livestock.

Most farmers were not aware of the breeds' name they reared but distinguished them by coat and eye colours. For those who were aware of breeds they reared, majority acknowledged rearing New Zealand White and Flemish giant because of their large mature weight. The findings concur with those of Olagunju, Adeniyi, & Oladele (2018) that the common rabbit breeds in Kenya are New Zealand White, Chinchilla, Californian White, Flemish giant and their crosses. The same findings are echoed by Hungu et al (2011) that the two breeds are suitable for meat production thus primary objective of the Kenyan rabbit farmers.

Findings showed that rabbit farming had a reason attached to it. Surveyed farmers reared domestic rabbit for meat whether for sale or for home consumption, as pets, for skin and fur and for manure. The findings are in line with those of Mbutu (2013) that rabbits have been associated with several benefits such as meat provision as the main focus of consumption and sales with extensive test showing that rabbit meat is the most nutritious meat known to man. In addition, other useful by products from domestic rabbits include skin, wool and organic manure.

### Housing of rabbits

The housing of rabbits has been emphazised by (Mailafia, Onakpa & Owoleke, 2010) in rabbit production. High proportion of respondents indicated they reared their rabbits in cages rather than free range system. This could be for protection from naïve predators such as birds of prey

(Courchamp, Langlais & Sugihara, 2000), mongooses among others. The measurement of the rabbit house measured 1.5m by 1.5m and above which agrees with Hungu et al (2013). The measurements were large than those specified by Mailafia, Onakpa & Owoleke, (2010) as more than one rabbit is housed in the same structure. Majority of the structures were raised about a metre from the ground as anti-predation tactics against dogs, cats and mongooses (King, 2019). These findings confirm previous reports that the FAO guidelines in Szendrő et al., (2012) on the construction of rabbit hutches can be modified and adopted by local farmers.

**Source of rabbit breed**

Most farmers indicated that they sourced breeding stocks from other local farmers with emphasis focusing on size and beauty of the breed and advice from farmers. This is attributed to the fact that there is low awareness of rabbit farming in both regions and local agricultural extension officers are insufficient in the areas for advices to the farmers. Oseni et al., (2014) also observed this practice and this is a drawback to farmers from genetic material access. In addition, Mbutu (2013), adds that traditionally in Meru community, adults do not discuss rabbits' issues, since they think that it benefits only small boys.

Majority of farmers indicated that they provided six females to one male for breeding purposes. This is in consistence with Schaeffer et al., (2008) and Hungu et al (2011) findings that 1 male served approximately 5 females which is known by small scale farming depending on number of does and mating practice.

Large proportion of respondents indicated that they provided pregnant does with nesting boxes where approximately between 6 and 10 young ones per doe were born. Jaouzi et al (2006) report had a mean of 7.2 per birth for 95.1% of sampled farmers. The findings are in line with those of Hungu et al (2011) where in their study observed an average litter size of 7 kits. Matics et al (2014) on a local population in traditional breeding, reported a birth litter size differing from 5 to 8 with 7 to 7 alive at birth. Females were recorded to eat some of the weak young ones by majority of farmers. Rabbits may eat their young kits (Cochran, 2019) of stress, rejection, or inexperience with having kits even though not very often. Majority of rabbits were sold when at an age of more than three months but less than five months similar with Karikari and Asare (2009) and Hungu et al (2011) with a market price ranging from KSH. 200 to 1200 with majority selling at an average of ksh. 200 to 500.

**Rabbit house cleaning practices**

Farmers were asked to indicate their various major supply of water to their farm. A large fraction of them indicated that they relied on dug out wells while few relied on seasonal ponds. In north rift region, community rely on seasonal ponds (*tabar*) for domestic water supply due to climatic weather conditions that do not favour free flowing water such as in rivers. A large proportion of farmers indicated they never cleaned rabbit houses which in disagrees with Hungu et al (2011) that farmers in central region of Kenya practice routine general hygiene, whereas in this study majority of rabbit farmers practicing manure removal only followed by those who sprinkled ash (*jivu*) as a disinfectant as well as adding more fresh straw.

**Rabbit feeding**

Majority of farmers never gave rabbit water as they do not take it and for fear that they may die of diarrhoea. Varieties of feeds were given to rabbits ranging from Commercial Pellets to kitchen Left overs. Majority of farmers fed rabbits with vegetables plucked or uprooted from farms. Samkol & Lukefahr (2008) indicated unexpensive rabbit feeding programme as they can be fed from forage and garden waste. A large proportion of farmers avoided commercial rabbit feed attributing it to high cost. In addition, farmers not trusting feed companies as Hungu et al (2011) indicated could have been the reason too. The rabbit enterprise being carried out by youths who are in school and cannot afford money to buy commercial feed could also have contributed to

rabbits being fed mainly with vegetables. Gichoya, (2013) low capital for rabbit farming that is associated with obtaining the start-up stock which is an impending task for most business aspiring entrepreneurs. Similarly, rabbits do not need elaborate houses or equipment because their requirements are not as complicated as for other animals and thus this enterprise fitted youths best.

**Production problems and diseases**

Rabbit farmers indicated that they encountered problems while practicing rabbitry. These problems were diseases (Ogolla et al., 2017) like diarrhoea and skin diseases, predators such as dogs and mongooses, thieves (from other rabbit keepers) among others. Domestic rabbits are prone to predators such as dogs and this drives farmers to build raised cages about one metre from the ground as it was observed during the survey. Mortality of the rabbits/ sudden deaths, and high costs of commercial food (pellets) building materials such as nails and iron sheets also constraints the enterprise as Kumar and Guleria (2010) noted in Hungu et al., (2011).

## CONCLUSION AND RECOMMENDATIONS

From the findings, farmers kept other types of livestock and rabbit farming was not their main type of farming. This need to be addressed and more awareness created on the need to keep rabbits for meat provision, manure skin and fur as well as for commercial purposes as they occupy small space in comparison to other livestock.

High proportion of respondents reared their rabbits in cages. It was observed that the cages were not well constructed and materials were not up to standards. This could be the reason as to why rabbit farmers indicated that the constraining factor for rabbit farming was predator and diseases. More awareness should be created to educate farmers on the need to offer proper housing to rabbits and follow the FAO recommendations. Supply of subsidized building materials for the construction of ideal rabbit hutches and technical support to ensure hutches of proper quality and size are used in rabbit production is recommended.

Sourcing of breeding stock from fellow local farmers was observed in this study. This was attributed to the fact that there is low awareness of rabbit farming in both regions and agricultural extension officers to educate the farmers on genetic differences in rabbit breeding.

Most farmers never gave their rabbits drinking due to their ignorance and this had made them fear that they may die of diarrhoea. Managerial practices and marketing strategies` training are required by the rabbit farmers in the regions. Supply of subsidized commercial feed to ensure food of proper quality in rabbit production is recommended. This will eventually bring an increase in rabbit farming in the two regions that will increase meat yields for food security and sustainability. By so doing, the households in the nation will adopt the practice and the outcome will boost their families both healthwise and increase in income from the yields from the rabbit meat.

Other benefits from rabbit manure will be increase in crop farming also for food security and improved livelihoods.

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