Livestock industry has always been a vital component of the economic and social structure in Lesotho. Horses are among other livestock that are mostly owned by Basotho farmers. Limited road infrastructure here in Lesotho particularly in remote areas of the country make horses to be the most relevant animal to be kept by many small holder farmers. Horses undertake several activities on a daily basis which include the transportation of goods and people, and most importantly they have a prominent position in agricultural system in the country. Furthermore, horses transport goods to and from markets, farms and shops, traveling long distances. Urban dwellers are able to generate income through the use of equine in door to door transportation services (Tesfaye and Curran, 2005).

Despite the increasing importance of horses, horse farming is still hampered by frequent outbreaks of diseases and of these diseases, infections by GIPs accounts for a con-
considerable damage and massive economic losses especially in young horses (Upjohn et al., 2010). GIPs occur perva-
sively in horses and present a cardinal veterinary concern 
throughout the world. The study conducted in Ethiopia by 
Wedajo and Hadush (2017) revealed that GIPs are one 
of the most common factors that constrain the health and 
working performance of horses. The damage done by GIPs 
on horses vary depending on the species and number of 
parasites, nutritional and the immune status of a host (Asef 
et al., 2011). Anthelmintics have been the mainstay in the 
control of GIPs in many countries; however, resistance 
to the earlier registered anthelmintics has been reported 
many times (Traversa et al., 2012).

In this context, the use of management practices in an in-
tegrated manner is essential for an effective control of par-
asitic diseases as well as reducing the spread of resistance 
to anthelmintic (Molento et al., 2009). The management of 
 pastures is one of the effective practices to mitigate internal 
parasites in grazing livestock (Stuedemann et al., 2004). 
Pasture rotation with optimum rest period is an important 
component to minimize internal parasites in grazing ani-
mals (Colvin et al., 2008). Moreover, the study conducted 
by Relf et al. (2013) has revealed that lack of rotational 
grazing practices was associated with a higher prevalence 
of cyathostomin egg excretion. The study of Kumar et al. 
(2013) has revealed that animals that are kept in good living 
conditions are able to resist or tolerate internal parasites as 
compared to animals kept under poor housing conditions. 
Madke et al. (2010) have suggested that animal housing 
must be well ventilated to maintain required humidity and 
air circulation. The growth of parasites population is ac-
celerated in high humid and low light. The work of Hughes 
and Kelly (2006) revealed that nutrition is directly associ-
ated with susceptibility of animals to parasitism as some 
minerals including zinc, iron, cobalt, sodium etc. are essen-
tial to develop functional immunity against the parasites.
The objective of this study was to determine the influence of 
AEZs on farmers’ level of knowledge on GIPs, the hus-
bandry practices and the control measures used among 
farming communities.

METHODOLOGY

STUDY DESIGN
A cross sectional study was conducted by way of personal 
interviews with horse owners from nine villages selected 
through stratified random sampling.

SAMPLING AND DATA COLLECTION
The sample size was determined using the formula sug-
gested by Taherdoost (2017).

N= sample size

Using this formula, a total of 384 respondents were re-
quired for sampling however, the number of available 
participants was limited in the sampled areas to meet the 
required number. Given this condition only 144 respond-
ents were able to successfully partake in the study. Of these 
144, 48 respondents were from each of the three distinct-
ive AEZs being lowlands, foothills and mountains. From 
each AEZ two focus group discussions (FGDs) consisting 
of 15 horse owners were made and this is according to 
Krueger and Casey (2009) who indicated that a group 
size seldom goes beyond 12 participants. From each focus 
group 9 respondents were randomly selected to participate 
on one-to-one interviews to collect additional data using 
individual interview schedule. The structured question-
naire was designed to obtain information regarding farm-
ers’ demographic characteristics, horse farming experience, 
knowledge on GIPs and horse husbandry practices with 
respect to GIPs.

DATA ANALYSIS
The data was analysed using the Statistical Package for the 
Social Sciences (SPSS) version 16.0 (IMB SPSS 2009). De-
scriptive statistics was employed to determine the percent-
ages and standard errors. The association between AEZs 
and the tested parameters was assessed by $\chi^2$ test. Where an 
overall or omnibus $\chi^2$ test was found to be significant (i.e., p < 0.05), the importance of different AEZs was tested using a post-hoc cell-wise adjusted standardized residual analysis 
as described in Garcia-Perez and Nunez-Anton (2003). For the purpose of this study the data from the FGDs was 
not analyzed instead the FGDs were used as precursor to 
a quantitative stage determining the issues to be covered 
in the structured interviewing and giving insights into the 
problems or opportunities that were being researched.

RESULTS

DEMOGRAPHIC PROFILE OF HORSE OWNERS
The results in Table 1 indicate that horses were mainly 
owned by men across the AEZs ($\chi^2= 4.32$, p= 0.11). The 
majority of horse owners attained primary level as the 
highest level of education with no significant association 
between level of education and AEZ ($\chi^2= 4.31$, p=0.36).

Training on equine related issues was received by few 
horse owners in the lowlands (7.4%), foothills (22.2%) and 
mountains (14.8%) and AEZ did not have any effect on 
the number trained ($\chi^2=2.34$, p=0.30).
Table 1: Demographic profile of horse owners’ in the three AEZs

| Category       | Lowlands (%) | Foothills (%) | Mountains (%) | SE  | $X^2$ | p-value |
|----------------|--------------|---------------|---------------|-----|------|---------|
| Gender         |              |               |               |     |      |         |
| Male           | 85.2         | 100           | 92.6          | 0.09| 4.32 | 0.11    |
| Female         | 14.8         | 0             | 7.4           | 0.21|      |         |
| Education level|              |               |               |     |      |         |
| Primary        | 63.0         | 77.8          | 51.9          | 0.11| 4.31 | 0.36    |
| High school    | 25.9         | 18.5          | 33.3          | 0.16|      |         |
| None           | 11.1         | 3.7           | 14.8          | 0.25|      |         |
| Equine training|              |               |               |     |      |         |
| Yes            | 7.4          | 22.2          | 14.8          | 0.22| 2.34 | 0.30    |
| No             | 92.6         | 77.8          | 85.2          | 0.99|      |         |

$X^2$ = Pearson Chi-Square value, SE= Standard error

Table 2: Farmers familiarity with common GIPs, their causes and age susceptibility

| Category                                | Lowlands (%) | Foothills (%) | Mountains (%) | SE  | $X^2$ | p-value |
|-----------------------------------------|--------------|---------------|---------------|-----|------|---------|
| GIPs as a problem in different AEZs     |              |               |               |     |      |         |
| Yes                                     | 96.3         | 100           | 100           | 0.09| 2.02 | 0.36    |
| No                                      | 3.70         | 0.00          | 0.00          | 0   |      |         |
| Common GIPs known by horse owners       |              |               |               |     |      |         |
| Nematode                                | 51.90        | 70.43         | 48.10         | 0.12| 5.48 | 0.24    |
| Cestodes                                | 7.41         | 3.71          | 18.51         | 0.22|      |         |
| Both NEM & CES                          | 40.72        | 25.91         | 33.39         | 0.15|      |         |
| Causes of GIPs                          |              |               |               |     |      |         |
| Grazing MGM                             | 63.0         | 66.7          | 51.9          | 0.12| 1.43 | 0.83    |
| Insufficient MEDS                       | 14.8         | 14.8          | 22.2          | 0.21|      |         |
| Insufficient feeds                      | 22.2         | 18.5          | 25.9          | 0.18|      |         |
| Age susceptibility to GIPs              |              |               |               |     |      |         |
| Foal                                    | 55.6         | 48.1          | 51.9          | 0.12| 9.84 | 0.27    |
| Weanling                                | 0            | 0             | 11.1          | 0.00|      |         |
| Adult                                   | 22.2         | 18.5          | 14.8          | 0.22|      |         |
| Both foal & adult                       | 18.5         | 33.3          | 22.2          | 0.18|      |         |

$X^2$ = Pearson Chi-Square value, SE= Standard error, NEM= nematode, CES= cestodes, MGM= Management, MEDS= medication

Farmers’ familiarity with GIPs in different AEZs

Infection by GIPs particularly nematode represent a major health threatening factor in horses as the majority of respondents in Table 2 affirmed GIPs as a problem. The results however revealed no association between AEZs and the number of farmers considering GIPs as a problem ($\chi^2= 2.02, p=0.36$). There was also no association between AEZs and the common GIPs known by respondents ($\chi^2= 5.48, p=0.24$). Among other age groups most respondents consider foals more susceptible to infection by GIPs and the majority of them attributed the infection to poor grazing management. AEZ on the other hand had no influence on age susceptibility to infection ($\chi^2= 9.84, p= 0.27$), and the causes of GIPs ($\chi^2= 1.43, p= 0.83$).

Control measures of GIPs in different AEZs

The majority of the interviewed respondents do not deworm their horses against GIPs except the few of them who use both ivermectin and fenbendazole. The choice of the anthelmintic used for the control of GIPs was not associated with AEZs ($\chi^2= 4.65, p= 0.58$). When measuring the dosage rate most respondents estimate horse weight instead of measuring the weight. Most respondents deworm their horses more than four times in a year however this was not influenced by AEZ ($\chi^2= 7.42, p= 0.12$).

Grazing management in different AEZs

The horses had access to rangelands which were mostly shared by more than three villages (Table 4). This study revealed that grazing alone did not provide adequate nutrition for the horses. The results further showed that AEZs...
Table 3: Farmers choice of anthelmintic and frequency of use to treat GIPs of horses

| Category                              | Lowlands% | Foothills% | Mountain% | SE  | X²   | p-value |
|---------------------------------------|-----------|------------|-----------|-----|------|---------|
| Do you deworm your horses             |           |            |           |     |      |         |
| Yes                                   | 70.4      | 77.8       | 81.5      | 0.10| 0.96 | 0.61    |
| No                                    | 29.6      | 22.2       | 18.5      | 0.17|      |         |
| Type of commercial medication used    |           |            |           |     |      |         |
| Ivermectin                            | 14.8      | 7.4        | 14.8      | 0.78| 4.65 | 0.58    |
| Fenbendazole                          | 0         | 7.4        | 3.7       | 0.57|      |         |
| Do not use drugs                      | 70.4      | 55.6       | 59.3      | 0.82|      |         |
| How is the dosage measured            |           |            |           |     |      |         |
| Guessing weight                       | 37.0      | 44.4       | 48.1      | 0.80| 7.42 | 0.12    |
| Measuring weight                      | 0.0       | 0.00       | 0.0       | -   |      |         |
| Estimating age                        | 14.8      | 33.3       | 33.3      | 0.76|      |         |
| Frequency of use of medication        |           |            |           |     |      |         |
| Annually                              | 3.7       | 11.1       | 0.0       | 0.50| 10.78| 0.09    |
| Seasonally                            | 22.2      | 25.9       | 37.0      | 0.16|      |         |
| More than four times                  | 25.9      | 40.7       | 44.4      | 1.42|      |         |

X²= Pearson Chi-Square value, SE= Standard error

Table 4: Grazing management of horses

| Category                              | Lowlands(%) | Foothills(%) | Mountains(%) | SE  | X²   | p-value |
|---------------------------------------|-------------|--------------|--------------|-----|------|---------|
| Access to grazing                     |             |              |              |     |      |         |
| Yes                                   | 100.0       | 100.0        | 100.0        | 0.09| -    | -       |
| Grazing nutrition adequate            |             |              |              |     |      |         |
| Yes                                   | 33.3        | 22.2         | 40.7         | 0.15| 2.15 | 0.34    |
| No                                    | 66.7        | 77.7         | 59.3         | 0.11|      |         |
| Rotational grazing                    |             |              |              |     |      |         |
| Yes                                   | 100.0       | 85.2         | 100.0        | 0.09| 8.41 | 0.01    |
| No                                    | 0.0         | 14.8         | 0.0          | 0.00|      |         |
| Villages sharing grazing              |             |              |              |     |      |         |
| 1                                     | 29.6        | 18.5         | 14.8         | 0.21| 3.62 | 0.45    |
| 2                                     | 0.0         | 7.4          | 7.4          | 0.28|      |         |
| >3                                    | 70.4        | 74.1         | 77.8         | 0.10|      |         |
| Mixed grazing                         |             |              |              |     |      |         |
| Yes                                   | 37.0        | 33.3         | 29.6         | 0.16| 0.33 | 0.85    |
| No                                    | 63.0        | 66.7         | 70.4         | 0.11|      |         |
| Removal of manure from grazing lands  |             |              |              |     |      |         |
| Yes                                   | 29.6        | 14.8         | 18.5         | 0.20| 1.93 | 0.38    |
| No                                    | 70.4        | 85.2         | 81.5         | 0.10|      |         |

X²= Pearson Chi-Square value, SE= Standard error

did not affect the number of villages sharing grazing lands ($\chi^2= 3.62, p= 0.45$). The $\chi^2$ test revealed an association between an AEZ and rotational grazing ($\chi^2= 8.41, p= 0.01$), however the post-hoc cell-wise adjusted standardized residual test confirmed that the association was not significant ($p>0.05$). Mixed grazing is not common among farming communities however, this is not influenced by AEZ ($\chi^2= 0.33, p= 0.85$). The results of the current study also showed that the grazing lands were highly contaminated since few respondents remove manure from grazing lands and this was not different between AEZs ($\chi^2= 1.93, p= 0.38$).
### Table 5: Management practices of horses

| Category                             | Lowlands(%) | Foothills(%) | Mountains(%) | SE  | $X^2$ | p-value |
|--------------------------------------|-------------|--------------|--------------|-----|-------|---------|
| Do you keep horses in roofed stall?  |             |              |              |     |       |         |
| Yes                                  | 11.1        | 7.4          | 18.5         | 0.23| 3.60  | 0.46    |
| No                                   | 85.2        | 92.6         | 81.5         | 0.10|       |         |
| Frequency of cleaning stall          |             |              |              |     |       |         |
| Do not clean                         | 66.7        | 51.9         | 63.0         | 0.11| 6.03  | 0.41    |
| Once a month                         | 11.1        | 29.6         | 22.2         | 0.18|       |         |
| Fortnight                            | 7.4         | 0            | 7.4          | 0.28|       |         |
| Only after rains                     | 14.8        | 18.5         | 7.4          | 0.28|       |         |
| Use feed supplements                 |             |              |              |     |       |         |
| Yes                                  | 33.3        | 37.0         | 48.1         | 0.13| 1.34  | 0.51    |
| No                                   | 66.7        | 63.0         | 51.9         | 0.12|       |         |

$X^2$: Pearson Chi-Square value, SE= Standard error

### The management practices in different AEZs

The higher percentage of the horses was kept under unroofed stalls which were rarely cleaned (Table 4). An AEZ had no influence in keeping of horses under roofed stalls ($\chi^2 = 3.60$, $p = 0.46$) and frequency of cleaning stalls ($\chi^2 = 6.03$, $p = 0.41$). Few respondents provided feed supplements to their horses and this was similar between different AEZ ($\chi^2 = 1.34$, $p = 0.51$).

### DISCUSSION

The results in Table 1 which show that horses were owned mostly by men than women coincide with those of Yisehak (2008) who indicated that a common perception is that women are more likely to own small stock, such as chickens, sheep and goats, than larger animals. These can also be associated with the fact that women’s role in livestock production in developing countries has been limited by cultural biasness that underestimate their contributions and potentials. Patel et al. (2016) also showed women are constantly confronted with constraints hindering them to access natural resources, marketing opportunities and financial services. These constraints often prevent women from accomplishing their full potential within the agricultural sector, including livestock.

The results as presented in Table 1 concur with the findings of Ifitikhar et al. (2007) who reported primary education as the highest level of education attained by most farmers. These results suggest that most horse owners can read and write however with little understanding of English. Torres-Acosta and Host (2008) explained that farmers’ ability to read and understand the drug labels was found to be critical in ensuring the correct use of anthelmintic drugs which sustains their long-term effectiveness. Earlier studies have documented that literacy is a crucial factor in agricultural innovation (Adeleye et al. 2016). The limited training sessions in equines as illustrated in Table 1 could be traced back to the less development of equine industry in Lesotho. Along with different factors Ifitikhar et al. (2007) reported training as an important activity that should constantly be done in order to impart new knowledge, skills, behavior and attitude on farmers for improved farming practices. Given the world wide raising concern of parasites resistance to commonly used anthelmintics, it would be of a great importance that farmers are trained on the latest means that are recommended in controlling GIPs. Training helps farmers to incorporate the latest scientific advances and technology tools into their daily operations including parasites control.

The results illustrated in Table 2 which show that farmers were aware and considered infection by GIPs as a major challenge concur with Wannas et al. (2012) who reported higher susceptibility of horses to a large number of parasites. Horses among farming communities are constantly confronted with infection by nematode than other GIPs and this agrees with the findings of Kompi et al. (2021) who confirmed higher prevalence of nematodes in a study conducted in Maseru District Lesotho. Although grazing lands represent the major source of nutrition for most horses among farming communities in Lesotho, most respondents associate the occurrence of GIPs to grazing lands due to the fact that in most cases they are over stocked and this assumption is supported by Rendle et al (2019) who indicated that helminth pasture burdens are likely to increase with increasing stocking density.

The higher prevalence of GIPs in foals reported by horse owners in different AEZs concur with the work of Kompi et al. (2021) who proved susceptibility of young animals to infection by GIPs than other age groups. Higher infection rates and more severe infections reflect lack of immunity in younger animals (Belete and Derso, 2015). There is an increasing likelihood of having parasites resistance to commonly used anthelmintics among farming commu-
nities as a result of approximating animal weight when measuring dosage rate. Approximating the weight of an animal could lead to inaccuracy that may result to under dosing which is believed to encourage the development of resistance because sub-therapeutic doses might allow the survival of heterozygous resistant worms (Shalaby, 2013). The higher frequency of use of anthelmintic among farming communities as reflected in Table 3 further suggests increasing possibilities of parasites resistance. According to Matthews (2014) high treatment frequency has led to considerable selection pressure for anthelmintic resistance. Although the results in Table 4 indicate that rotational grazing was highly practiced among farming communities, the fact that grazing areas are rarely cleaned and are mostly shared by more villages, suggest that such areas are over stocked. Over stocking predispose animals to infection by GIPs as Shalaby (2013) stated that stocking rate is an important consideration in parasite control as it affects exposure to infective larvae and contamination of the pasture. The findings of this study further revealed higher likelihood of pasture contamination due to poor pasture management in terms of faecal collection from the grazing areas. According to Tzelos et al. (2017) frequent faecal collection is proven to be effective in reducing numbers of eggs shed in faeces although this is labour intensive. The limited practice of mixed grazing suggests that horses in the study area were at higher risk of being infected with GIPs as Kumar et al. (2013) has also indicated that mixed grazing minimizes GIPs infection because several parasite species cannot infect two animals of different species. Most respondents in Table 4 reported that their horses were not nutritionally satisfied from grazing alone. Under these circumstances one would expect that horses would be fed supplementary feed but the results in Table 5 show that the majority of owners did not provide extra feed to their horses. Given this condition it is apparent that most horses lack some important minerals hence why they were susceptible to infection by GIPs. In support of these findings, Kumar et al. (2013) indicated that availability of vitamins, minerals and other nutrients are directly associated with susceptibility of animal to the parasites. The horses that were kept under unroofed stalls which were rarely cleaned as reported in Table 5, also exposed them to GIPs infestation. According to Kumar et al. (2013) animals reared under good management system tend to possess strong immunity and demonstrate resistance to infectious diseases.

CONCLUSION

With the findings of this study it is concluded that AEZ has no influence on farmers demographic and socio-economic profile, knowledge and control of GIPs of horses.
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