CHAPTER 6

Summary and General Conclusion

6.1 Summary

This research project incorporates four studies. The first study was aimed at establishing the effect of feeding level and season on the growth performance of Koekoek chickens. The growth performance parameters studied included weight for age, body weight gain, feed intake and feed conversion ratio (FCR). The feeding level and season played a significant ($p<0.05$) role on the growth performance of Koekoek chickens. At 18 weeks of age, the body weights of chickens that were full-fed in the rearing phase (AA and AR) were 0.39 kg heavier than those of chickens that were fed restrictedly (RA and RR). Restricted feeding hindered the body weight gains of chickens by 42.1% as compared to chickens that were full-fed in the rearing phase (10-18 weeks). Koekoek chickens that were full-fed during the rearing phase were more ($p<0.05$) efficient in converting feed into body weight (5.4) than the ones that were fed restrictedly (6.74). During the laying phase (19 to 32 weeks), the average body weight of Koekoek chickens that were allotted to the RA treatment was 0.2 kg , 0.8 kg and 0.7 kg higher ($p<0.05$) than the ones in chickens that were in treatments AA, AR and RR respectively. In terms of the body weight gain chickens in the AR treatment scored significantly ($p<0.05$) lower (164.6g) body weight as compared to chickens that were in the AA, RA and RR treatments with the weight gains of 1126g, 721.7g and 501.9g respectively. Restricted feeding only in the rearing phase (RA) improved the feed conversion ratio by 37.1%, 79.6% and 40.2% when compared to chickens that were in the AA, AR and RR treatments respectively. On the other hand season had a significant ($p<0.05$) effect on the growth performance of Koekoek chickens. The body weights of chickens that were reared in winter were significantly ($p<0.05$) lower (1223g) than those of chickens reared in summer season (1547g) at first oviposition (18 weeks). The final body weights of chickens that were reared in summer were higher than those in winter. Koekoek chickens that were reared during the summer gained more than chickens that were kept in winter for the period from 10 to 18 weeks of age. From 19 to 32 weeks of age, winter conditions suppressed the weight gain of Koekoek chickens by 7.05% as compared to the weight gain of chickens that were exposed to summer conditions. An average feed conversion ratio (FCR) of chickens that were reared during the summer was lower (4.4:1 than the FCR of chickens that were reared during the winter (7.8:1). The summer conditions improved the overall feed efficiency by 25.55% compared to winter conditions. The mortality rate and feed intake were high in chickens that

were reared in winter. The body weights, weight gains, feed intakes and FCR were significantly ($p<0.05$) affected by the interaction between the feeding level and season.

The second study focused on the effect of feeding level and season on the carcass characteristics of Koekoek chickens at the ages of 18 and 32 weeks. At puberty (18 weeks) feed restriction lowered the slaughter weight, defeathered weight, dressing weight, skin weight, breast muscle weight, chest width and heart girth by 21.5%, 25.9%, 13.8%, 7.6%, 21.2%, 18.6% and 28.8% respectively in Koekoek chickens as compared to those that were full-fed. The mean weights of the intestines, liver and abdominal fat were significantly ($p<0.05$) higher in full-fed chickens (64.6g, 58.4g and 31.7g) compared to feed restricted chickens (22.4g, 54.2g and 26.2g). The shank width, slaughter weight, defeathered weight, chest width, heart girth, dressing weight, breast muscle weight, skin weight and skin percentage of chickens that were reared in summer were 33.5%, 16.7%, 12.9%, 39.3%, 12.2%, 29.9%, 24.9% and 9.5% respectively higher ($p<0.05$) than those of chickens that were reared in winter. The shank length, defeathered percentage, carcass dressing percentage and muscle dressing percentage were significantly ($p<0.05$) higher in chickens that were reared in winter (67.4mm, 86.0%, 71.6% and 5.3%) compared to chickens reared in summer (64.4mm, 82.3%, 68.4% and 4.1%). The summer conditions increased the abdominal fat pad weight, abdominal fat percentage, intestine weight and liver weight by 15.6g, 0.6%, 10.3g and 4.6g compared to winter conditions. The gizzard weights and gizzard percentage were lower ($p<0.05$) in chickens that were reared during summer by 2.8g and 0.6% respectively compared to those reared in winter. Carcass characteristics (defeathered weight, dressing weight, dressing percentage, breast muscle weight, breast muscle percentage, skin weight and skin percentage) abdominal fat pad and internal organs were not statistically ($p<0.05$) affected by the interaction between the feeding level and season during the rearing period (18 weeks). At the age of 32 weeks, Koekoek chickens that were full-fed during the laying phase (AA and RA) performed better ($p<0.05$) than chickens that were subjected to restricted feeding during the laying phase (AR and RR) in terms of slaughter weight, defeathered weight, heart girth, dressing weight and breast muscle weight. The shank length and chest width of chickens that were under RR treatment (67.3mm and 59.3mm) were significantly ($p<0.05$) lower than that of chickens in treatments AA (69.6mm and 65.2mm) and RA (69.6mm and 63.9mm) but statistically similar ($p>0.05$) to the shank lengths and chest widths of chickens that were under AR treatment (67.3mm and 59.3mm). The skin weights of chickens that were under AA treatment were heavier ($p<0.05$) than the skin weights of chickens that

were subjected to AR, RA and RR treatments. The relative skin percentage for chickens that were allotted to AA treatments (7.5%) was higher ($p<0.05$) than that of chickens that were under AR (6.7%), RA (6.8%) and RR (6.7%) treatments. The slaughter weight, defeathered weight, chest width, heart girth, carcass dressing weight, and skin weight of chickens that were exposed to summer conditions were 25.7%, 18.1%, 21.9%, 9.2%, 23.2% and 9.2% higher than the ones that were exposed to winter conditions. On the other hand the shank length, shank width and skin percentage were higher in winter (70.6mm, 12.1mm and 7.1%) than in summer (66.9mm, 10.8mm and 6.5%). The defeathered percentage, carcass dressing percentage, breast muscle weight and breast muscle percentage were similar between the different seasons. The feeding level and season interaction played a significant ($p<0.05$) role on shank width, slaughter weight, defeathered weight, chest width, dressing weight, breast muscle weight, skin weight and skin percentage. The abdominal fat weight, liver weight and gizzard weight were significantly ($p<0.05$) higher in Koekoek chickens that were full-fed during the laying phase (AA and RA) compared to those that were fed restrictedly during a similar period (AR and RR). The abdominal fat and gizzard percentages were higher ($p<0.05$) in chickens that were under AA treatment (5.3% and 1.6%) compared to those that were under AR treatment (3.8% and 1.8%) and RR treatment (4.1% and 2%) but not significantly ($p>0.05$) different from those that were subjected to RA treatment (4.5% and 1.7%). The feeding level had no effect ($p>0.05$) on the performance of chickens in terms of intestine weights and liver percentage. The winter conditions impacted ($p<0.05$) positively on abdominal fat weight, abdominal fat percentage, intestine weight, intestine percentage and liver percentage of Koekoek chickens with the records of 95.8g, 5%, 69.1g, 3.7g and 2% in comparison to those that were exposed to summer conditions (91.3g, 3.8%. 69g, 3.1% and 1.6%) respectively. The liver weight and gizzard percentage were statistically ($p>0.05$) similar regardless of the season. The feeding level and season significantly ($p<0.05$) affected the relative weights of the intestine and liver as percentage of body weights.

The third study was conducted to determine the effect of restricted feeding and season on the carcass chemical composition of Koekoek chickens. The chemical composition was done in meat from chickens of 18 and 32 weeks of age. At the age of 18 weeks both feeding level and season had a significant ($p<0.05$) effect on the chemical composition of meat from Koekoek chickens. The meat produced by Koekoek chickens that were fed without restriction (AA and AR) had higher ($p<0.05$) fat content (43.4% and 41.5%) than those that were on restricted feeding (RA and RR) with the fat content

of 33.5% and 32.7% respectively. The dry matter and crude protein percentages were on average higher ($p<0.05$) in full-fed chickens (96.8%) compared to feed restricted ones (89.6%) while the percentage of crude protein was significantly ($p<0.05$) higher in chickens that were feed restricted (50.4%) than in full-fed chickens (39.4%). Dry matter and crude protein percentages were significantly ($p<0.05$) higher in chicken meat produced during the summer (94.1% and 46.4%) than those fed restrictedly (92.2% and 43.3%). The ash and fat contents were not affected by the season. Dry matter content was significantly ($p>0.05$) lower (95.2%) in the meat of chickens that were subjected to AA treatment than from the meat produced in Koekoek chickens that were subjected to AR (95.9%), RA (96%) and RR (96%) treatments. Chickens that were full-fed during the laying phase (AA and RA) had higher ($p<0.05$) fat content (51.9% and 50.2%) followed by the ones that were under AR treatment (45.3%) with Koekoek chickens that were feed restricted in both phases (RR) registering the lowest ($p<0.05$) fat content (40%) at the age of 32 weeks. The crude protein content from meat produced by chickens that were subjected to RR treatment were 12%, 7.1% and 7.5% respectively higher than those from chickens that were in treatments AA, AR and RA. The ash content was similar across the four feeding level treatments. At the age of 32 weeks, it was discovered that the dry matter content in meat produced during the summer was 1% higher than that in winter. The winter conditions enhanced the ash, fat and crude protein contents by 4.4%, 6.7% and 17.7% compared to summer. The feeding level and season interaction only had a significant ($p<0.05$) effect on the dry matter content of meat from Koekoek chickens.

The fourth study was conducted to establish the effect of restricted feeding and season as well as their interaction on the reproductive performance of Koekoek chickens from 18 to 32 weeks of age. The reproductive performance in Koekoek chickens was done through the evaluation of combs, wattles, pubic bones, oviducts and ova. At the age of 18 weeks the comb and wattle lengths of Koekoek chickens that were full-fed during the rearing phase (AA and AR) were longer ($p<0.05$) than the combs and wattles of chickens that were feed restricted (RA and RR). The combs of chickens that were allocated to RA (54.6mm) and AA (53.1mm) were longer ($p<0.05$) than the ones that were subjected to AR (51.5mm) and RR (51.7mm). However, the comb lengths of chickens that were under AA and RR treatments were not significantly ($p>0.05$) different. The wattle lengths were similar among the four feeding level treatments at the age of 32 weeks. The combs and wattles were significantly ($p<0.05$) longer in Koekoek chickens that were reared during the summer (37.8mm and

21.9mm) compared to those of chickens that were reared in winter (22.2mm and 15.3mm) at the age of 18 weeks. Fourteen weeks later the comb lengths of chickens reared in summer were 19.8% longer than the combs of their counterparts that were reared in winter while the wattle lengths were not significantly ($p>0.05$) affected by the feeding level. The interaction between the feeding level and season played a significant ($p<0.05$) role on the enlargement of combs and wattles during the first eight and four weeks respectively from the onset of puberty. At 18 weeks of age the distance between the pubic bones was wider ($p<0.05$) in chickens that were fed without restriction (AA and AR) as compared to the ones that were fed restrictedly during the rearing phase (RA and RR) with the records of 24.4mm and 15.6mm respectively. At the age of 32 weeks chickens that were in AA and RA treatments (48.9mm and 48.8mm) had a wider ($p<0.05$) distance between the pubic bones than those that were in AR and RR treatments (43.9mm and 44.5mm). The ova and oviduct weights of Koekoek chickens that were full-fed (AA and AR) were heavier (16.00g and 15.36g) than those of chickens that were in RA (5.6g) and RR (5.5g) at the slaughter age of 18 weeks. At the age of 32 weeks the ova and oviduct weights were statistically ($p>0.05$) similar between the different feeding level treatments. The distance between the pubic bones and the combined weight of ova and oviducts of chickens reared during summer were 34.7% and 51% higher than that of chickens that were reared during winter respectively at 18 weeks of age. The weights of the ova (45.5g) and oviducts (50.7g) of chickens produced during summer were heavier ($p<0.05$) than the ova and oviducts of chickens produced in winter (47.5g and 47.9g) during the laying phase (32 weeks). The spread of the pubic pins was not affected by season at the age of 32 weeks in Koekoek chickens. The feeding level and season interaction had an effect ($p<0.05$) on the ova and oviduct weights at the age of 18 weeks as well as the spread of the pubic bones at 32 weeks of age.

At the age of 18 to 20 weeks only chickens that were full-fed during rearing (AA and AR) started laying while those that were in restricted fed treatments (RA and RR) commenced their laying cycle on the 21st week. However, a week later (22 weeks) chickens under RA treatment were second (15.4%) from the ones that were under AA treatment (19.5%) with respect to laying percentage though they were not significantly different from chickens that were subjected to AR treatment (14.3%). During the last week of the study the laying percentage of chickens that were under RA treatment (72.8%) were statistically similar to chickens that were in AA treatment (71.9%) while the laying percentages of chickens that were feed restricted during the laying phase (AR and RR) were lower with the records

of 65.5% and 65.2% respectively. Winter delayed egg laying by six weeks in Koekoek chickens as compared to summer. At the age of 23 weeks, the laying percentage in chickens that were reared in summer was 50.1% higher than the laying percentage of chickens that were reared in winter. The final egg laying percentages (32 weeks) were 72.9% and 64.9% for Koekoek chickens that were reared during summer and winter respectively. The feeding level and season interaction influenced egg production of Koekoek chickens ($p<0.05$). Egg weights of chickens were initially lower ($p<0.05$) in chickens that were feed restricted during the rearing and laying phases (RR) (up to 25 weeks). At the age of 32 weeks the egg weights produced from chickens that were in RR treatments (46.9g) were statistically($p>0.05$) similar to egg weights from chickens that were under AA (49.2g), AR (43.9g) and RA (50.2g) treatments. The average egg weights of chickens that were full-fed during the laying phase (AA and RA) were heavier (45.6g and 46.7g) than those of chickens that were feed restricted during the same phase (AR and RR) with 43.5g and 43.1g respectively. At the age of 25 weeks, the eggs produced during the summer season were 18.1g heavier than the ones produced in winter. Seven weeks later the egg weights from Koekoek chickens that were reared in summer (48.2g) were not different ($p>0.05$) from the ones that were reared in winter (47g) even though the average egg weights were higher in chickens that were reared in summer (46.8g) compared to the ones laid in winter (42.6g). The average egg weights were affected by the interaction between the feeding level and season. Full feeding during the rearing phase (AA and AR) reduced the number of days to first oviposition by 8.2 days as compared to restricted feeding during the similar phase (RA and RR). Koekoek chickens that were subjected to RR treatment (168.3 and 199.4 days) delayed to reach 20% and 80% egg production in comparison to those that were under AA (163.5 and 191.7 days), AR (164.1 and 190.7 days) and RA (166.9 and 189.1 days) treatments. The summer conditions shortened the number of days to 1st oviposition, 20%, 50% and 80% egg production by 17.3, 22.93, 23.5 and 29.6 days as compared with winter conditions respectively ($p<0.05$). The feeding level and season interaction did not influence the number of days for different egg production stages except for the number of days to first oviposition. The feeding level and season as well as their interaction had no effect ($p>0.05$) on the production of abnormal eggs (cracks, soft-shelled, shell-less and double yolked) in Koekoek chickens. Restricted feeding during both rearing and laying phases (RR) resulted in higher average egg hatchability (90.9%) than AA, AR and RA treatments with the egg hatching percentages of 72.6%, 83.3% and 76% respectively. The egg hatching percentage in Koekoek chickens was neither affected

($p>0.05$) by warm summer conditions nor cold winter conditions. There was no significant interaction between the feeding level and season on the hatching percentage of Koekoek chickens.

6.2 General Conclusion

This study was aimed at determining the effect of restricted feeding and season on the productive and and reproductive characteristics of Koekoek chickens. The compensatory growth was evident during the laying phase as Koekoek chickens that were feed restricted during the rearing phase and later shifted to full feeding during the laying phase had improved body weight, body weight gain and feed conversion ratio. Unrestricted feeding during the rearing phase resulted in improved carcass characteristics excluding the relative percentage of the intestine, liver and gizzard. In chickens that were slaughtered at the age of 32 weeks full feeding during the laying phase resulted in improved carcass characteristics. Feed restriction reduced the dry matter, ash and fat content and improved the crude protein percentage of meat from Koekoek chickens. Slaughtering Koekoek chickens during the puberty stage in summer enhanced the dry matter and crude protein percentages of meat while ash, fat and crude protein percentages of those that were slaughtered at the age of 32 weeks were higher. The summer conditions enhanced the growth performance, slaughter weight, carcass dressing weight, breast muscle weight, skin weight, gizzard weight and chest width of Koekoek chickens. On average, the winter conditions hindered the laying percentage, egg weights and the number of days to 1st oviposition, 20%, 50% and 80% egg production.

Full feeding during the rearing phase appears to be an appropriate feeding management starategy with regard to growth performance, carcass characteristics, laying performance and the development of the reproductive organs. In order to have improved results from Koekoek chickens but with low feeding inputs, it would be more suitable if feed restriction is followed full feeding during the summer. Still there is a problem of rearing chickens in winter and therefore this call for further investigations on the housing system that will make it possible for the Koekoek chickens to remain productive throughout the year.

If this study was conducted for a longer period, it is ancipated that the effect of restricted feeding would be more evident. Therefore, further research is required to determine the productive and reproductive

performance of Koekoek chickens for at least 72 weeks. This study should be extended to include an economic analysis of the fourr feeding systems over a full production cycle of 52 weeks using appropriate housing for the particular seasonal requirements in Lesotho.