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# Coping with Climate Change Challenges by Feeding Indigenous Chickens under Intensive Systems in Namibia

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## Abstract

Floods that have hit Northern Communal Areas (NCAs) of Namibia in recent year pose feeding and other challenges to indigenous chicken. Indigenous chickens constitute a major source of livelihoods among rural farmers. The objective of this study was to determine the potential of intensive feeding of high and low plane of protein nutrition to indigenous chickens as one way of coping with environmental challenges caused by annual floods in the NCAs. Adequacy of protein inclusion in the diet is a viable option for improving the growth of small rural owned chickens. Two hundred and four indigenous chickens were subjected to two levels of plane of nutrition namely high and low plane of protein nutrition. At the low level, the protein was 18% in the 1-8 week age group, 16% in 9-22 week age group and 12% in the 23-36 week age. Feeding at high plane of protein nutrition was as follows; 23% in the 0-8 week age group, 20% in the 9-22 week age group and 16% in the 23-36 week age group. The control group was fed according to the Namibian poultry industry standards. The results showed significant and highest responses between the treatments in weeks 1-8 of age. Between 9-22 weeks, chicken mortality lowest at 5.6% in the high plane of nutrition group compared to 14.4% in the low plane of nutrition. The birds in control group consumed significantly ($P<0.05$) less feed than those fed with the high and low protein diet. Intensive feeding has a potential of alleviating nutritional stress of indigenous chickens under adverse environmental conditions. Farmers however, have to respond by cropping more intensively for the feed resources to be available.

**Keywords:** Environment; Floods; Indigenous chickens; Protein; Feeds

## Introduction

Indigenous chickens depend on scavenging resources which include kitchen left over, worms and whatever they can find in the surroundings. They are invariably reported as scavengers, reared under free range with little or no feed supplementation. According to various investigators, indigenous chickens are characterized by low productivity due to lack of adequate nutrition, prevalence of disease and lack of adequate management [1,2]. They are also regarded by many as an interesting tool to respond rapidly to rural poverty gaps.

Namibia of late has been experiencing flooding in the Northern Communal Areas (NCAs) where over 65% of the resource poor farmers live. The flooding is as result of the low lying areas of Northern Namibia which is downstream to the high rainfall areas of Southern Angola. As a result, when it rains in Southern Angola water flows in mass into northern Namibia and cause extensive flooding during summer months. Villages and homesteads are literally surrounded by huge pools of water for many months. This leaves village (indigenous) chickens with very little land to scavenge for feed. Moreover, the flooding brings in all sorts of health and environmental challenges. The cropping area which is the main source of village chickens' feed is drastically reduced creating shortages. It is with this in mind that this research was done to determine the possibility of intensifying indigenous chicken production by keeping them indoors and feeding them intensively in response to environmental challenges of flooding.

Nutrition in particular is one of the most critical constraints to poultry production under rural systems. A report from the villages of the central highlands of Ethiopia indicated that the protein and energy supplied from the scavenging feed resources (SFR), as determined from chemical analyses of crop contents of scavenging chickens averaged 8.8% and 2864 kcal/kg, respectively [3]. The above mentioned values seemed to be below the protein requirements of free ranging local hens of the tropics. Dessie and Ogle suggested that in order to increase and improve indigenous chicken production, additional inputs are required [4]. Environmental conditions like adequate housing conditions, temperature, humidity, solar radiation, rain, flooding, chilling weather make birds unable to withstand challenges posed by diseases and predators. Indigenous chickens constitute an important source of wealth among rural farmers. The chickens are used for special meals to honour visitors or at special functions like marriage and wedding ceremonies. They are also used in many situations like settling debts, score, and rituals and as immediate cash for school fees among many functions. Climate change is creating more problems for rural chicken production and various ways of responding to these environmental challenges need to be researched on.

## Objectives

The main objective of this study was to find out which is more suitable (high or low plane of protein) when intensifying indigenous chicken production and to find out the effect of confinement as a way of responding to environmental challenges like flooding in an arid country like Namibia.

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## Methods and Materials

### Site and experimental indigenous birds used

The experiment was carried out from the October 1st, 2007 to May 31st, 2008. A total of two hundred and four (204) young indigenous chickens aged between 2-7 days old of mixed sex were purchased from villages in the flood prone areas of Omusati and Oshana. The collection of the chicks was completed within three days and the chicks were kept in the same pen until the last day of collection. The birds were then transported to nearby Ogongo Agricultural College were facilities for intensification is readily available.

On Arrival at the experimental station the initial live weights of the birds were determined using a digital weighing scale. Chicks were provided with vitamin anti-stress (a medication against stress) administered in their drinking water. This vitamin was aimed at calming down the chicks because of the new experimental intensive environment in which they were to be raised. Feed consumption was recorded on weekly bases. Average live weight per bird was measured at weekly intervals by weighing the chickens in each pen and the total live weight was divided by the total number of birds in the pen to get the average live weight of the chickens. These live weights were used to calculate growth rates.

The Average Weekly Feed Intake (AWFI) by birds in all the treatment during the nine months of feeding was investigated and this was also used to calculate the daily feed intake.

### Management of the birds

The birds were housed in deep litter houses with a stocking density of 10 birds per square metre. The housing was made of cement concrete and zinc sheet roofing. All the houses were naturally ventilated, throughout the experiment. Wood shavings were used as litter. Tubular metal hoppers 40 cm in diameter carrying 10 kg of feed were used as feeders. All the birds had permanent access to fresh water provided to them in round plastic basins, 15 cm deep and 25 cm in diameter. Feed troughs were cleaned and filled with feed once per day.

The first four weeks of the experiment was regarded as an acclimatization period. This was in order to achieve uniformity and stabilize the weights of the chicks. From the fifth week of rearing, the chicks were randomly allocated into twelve groups.

### Experimental design

The experimental design was a factorial arrangement of treatments in a randomized complete block design, replicated four times. Blocking was done on initial weight. In the control group, the birds were fed standard commercial feed formulated for the Namibian commercial poultry industry. Table 1 presents the composition of the starter, grower and layer diets. The inclusion rates are on as fed (as is) basis. At the low level plane of protein, the dietary protein content was 18% in the first rearing stage (start-8 weeks), 16% in the second stage (9-22 weeks) and 12% in the third stage (23-36 weeks). At the high protein level, the dietary protein content was 23% in the 1-8 week age range, 20% in the second stage and 16% in the third stage.

Analyses of feed were done by an Animal nutritionist at Feed Master Pvt., Ltd Limited in Windhoek and raw feeds were bought from FEDCO Animal Pvt., Ltd in Windhoek. The mixing of the raw materials was done in the Department of Animal Science, Ogongo Agricultural campus of the University of Namibia.

Table 2 shows the nutrient composition of the feed treatments. The figures are presented on a dry matter basis.

### Measurements and sampling

Measurements such as weight, and food intake were taken on weekly basis. Mortality and any other abnormalities were recorded as they occurred daily.

Survival in percentage, weight gain, and feed consumption (feed intake) and feed conversion ratios were calculated for each pen using the following formulae:

$$\text{Survival}\,(\%) = \frac{\text{Final number of birds in the treatment}}{\text{Initial number of birds in the treatment}} \times 100 \quad (1)$$

$$\text{Weightgain}\,(\%) = \frac{(\text{Final average body weight-initial mean average body weight})}{\text{Initial mean average body weight}} \times 100 \quad (2)$$

Average body weight was recorded at the beginning and then weekly up to the end of the experiment using a digital balance.

$$\text{Feedconsumption}\,(\text{g}) = \frac{(\text{Amount of feed given-amount left in hopper and wastage})}{\text{Number of birds in the pen.}} \times 100 \quad (3)$$

Mortalities were recorded as they occurred.

### Chemical analysis of the chicken carcasses

At the end of the experiment, two birds were selected from each treatment. Birds were individually weighed, slaughtered, de-feathered

| Ingredients | Treatments Low protein level | | High protein level | | Control |
|---|---|---|---|---|---|
| | Starter | Grower | Starter | Grower | All weather diet |
| Yellow maize | 64.15 | 51.79 | 71.06 | 58.75 | 66.00 |
| Prime gluten | 1.33 | - | 3.57 | - | - |
| Bran | - | 10.0 | - | 10.0 | 5.00 |
| Hominy Chop | - | 10.0 | - | 10.0 | 7.15 |
| Sunflower | 15.0 | 15.0 | - | 5.96 | 10.00 |
| Import fish meal | 12.41 | 8.29 | 11.97 | 6.61 | 5.00 |
| P21Mono-calcium phosphorus | 1.10 | 0.92 | 1.2 | 1.15 | 0.80 |
| Bentonite | 4.75 | 2.69 | 10.74 | 6.10 | 5.00 |
| Limestone | 1.18 | 1.06 | 1.24 | 1.13 | 0.80 |
| Sodium chloride | 0.15 | 0.23 | 0.17 | 0.27 | 0.25 |
| Total | 100 | 100 | 100 | 100 | 100 |

**Table1:** Ingredients used in the experiment.

and eviscerated. Chemical analyses were performed on the breast with and without skin, and also on the thigh with and without skin with the aim of determining the following aspects: moisture, crude protein, calcium, phosphorous, ash and gross energy according to standard procedures of AOAC [5].

### Statistical analysis

The outcome variables were subjected to one-way analysis of variance (ANOVA) using the SAS statistical package [6].

## Results and Discussion

### Comparisons of observed mortality of chickens across the three dietary protein levels

Mortality experienced among the indigenous chickens in the present study from 0-32 weeks are presented in Table 3. The overall mortality experienced was very high at 42.2% of the total number of chickens used in the whole experiment. The highest mortality occurred between weeks 0-8 of age. Between 9-22 weeks, chicken mortality was reduced to 14.4% and then to 5.6% between 23-32 weeks. Visible disease symptom observed before chicks died during this period was diarrhea. However, a few chicks from each treatment were sampled and were taken to a veterinary diagnostic laboratory for investigation. The post-mortem performed on the samples did not find any pathological causes of mortalities. Factors such as cats and snakes predation also contributed to the chick mortality this was mostly due to snake bite during night hours. The cats and snakes are also to prone to being affected by reduced land area by flooding. So they were attracted to this high concentration of chickens for food. Ogongo Agricultural Campus is in a rural setting and hence was easily accessible by the predators. This mean any intensification effort by the rural farmers should be accompanied by vigilance in protecting their chickens through secure housing. Cannibalism, feather picking, peck order were some of the contributing factors to mortality.

The overall percentages loss or mortalities under intensive management reported in the current study was 42.2%. Mortality rate experienced in this study was comparable with what was reported in the study of Mopate and Lony [7] and little bit higher than those reported in previous studies of Pedersen, Demeke and Tadelle et al. [8-10].

Other possible reasons for the high bird mortality observed in the current study could have been due to factors such as; chicks trauma to new environments, unfamiliar feeding situation, mixing of chicks from different households and different villages, a sudden isolation of chicks from their mother hence lack of motherly care during the early stages of the experiment. Similarly Demeke [9], reported that the reason for high mortality of local chickens under intensive management was not being familiar to confinement conditions. In contrast Tadelle and Ogle [11] gave possible reason for high mortality of local chickens under intensive management as disease problems and nutritional deficiencies which the authors found to be a serious problem in local chickens than in exotic stock. Through observations, especially at night, chicks preferred to gather in a group especially in corners of the house and due to overcrowding some of the chicks died of suffocation. The problems of cannibalism and pecking observed in this study, was also reported by Savory [12] who blamed it on the deficiencies in essential amino acids. Pecking in indigenous chickens is thought to be a redirected foraging behavior rather than a form of aggression, and may be as a result of the hens' mistaken perception of feathers as appropriate foraging substrates [13]. Van Krimpen et al. [14] on the other hand reported that feather pecking has been shown to be negatively correlated with ground pecking, and it is thought that broody hens play a role in encouraging their chicks to explore their environment and perform ground-pecking behavior. The tendency to feather peck in domestic fowl is also thought to be influenced by experiences early in life. Indigenous chickens sometimes have to survive solely on scavenging especially where farmers do not give supplement; therefore scratching becomes part of their daily activities. However, during the survey, chicks together with their mother were seen scratching the ground in search of food and this in agreement with what was reported in previous studies.

### Feed consumption

The birds in control group consumed significantly ($P<0.05$) less feed than those fed with the high and low protein diet. Birds fed low protein tend to eat more but with less weight gain as compared to those that were fed on high protein level although no significant differences were observed. During feeding, some birds prevented others from eating and made some weaker birds stay away from the feed. This can be corrected by grouping chickens of the same size in a particular pen.

Indigenous chickens fed low protein level in current study

| Nutrients | Unit | Starter(0-8 weeks) | | Grower (9-22 weeks) | | Layers (23-32 weeks) | |
|---|---|---|---|---|---|---|---|
| | | Low | High | Low | High | low | High |
| **Metabolizable Energy** | **MJ/KG** | 12.4 | 12.4 | 11.9 | 11.9 | 11.5 | 11.5 |
| **Protein** | **g/kg** | 160 | 20 | 140 | 180 | 150 | 180 |
| **Lysine** | **g/kg** | 8.26 | 10.33 | 6.72 | 8.64 | 6.67 | 7.76 |
| **Methionine** | **g/kg** | 4.00 | 3.17 | 3.17 | 4.08 | 3.45 | 4.14 |
| **Methionine+cystine** | **g/kg** | 6.67 | 8.5 | 5.60 | 7.20 | 6.03 | 7.23 |
| **Calcium** | **g/kg** | 10 | 10 | 8.5 | 8.5 | 3.8 | 3.8 |
| **Phosphorus** | **g/kg** | 4.4 | 4.4 | 3.9 | 3.9 | 3.5 | 3.5 |
| **Sodium** | **g/kg** | 1.8 | 1.8 | 1.8 | 1.8 | 2 | 2 |

**Table 2:** Nutrients composition of the experimental diets.

| Age of birds in weeks | Number of birds which died | | High Protein | Initial number of birds | Percent mortality |
|---|---|---|---|---|---|
| | Control | Low Protein | | | |
| 1–8 | 0 | 30 | 28 | 204 | 28.4 |
| 9-21 | 12 | 6 | 3 | 146 | 14.4 |
| 22–32 | 6 | 1 | 0 | 125 | 5.6 |
| **Total** | **18** | **37** | **31** | | **42.2** |

**Table 3:** Chicken mortalities during 1-32 weeks of age.

consumed more feed as compared to those that fed on high level of protein which confirmation with the results of Boorman [15], who reported that chickens in general will increase their feed intake in response to marginal level of first limiting feed nutrients, independent on the nutrient requirement of the diet energy level and in this experiment protein was limiting nutrient. However, Emmans and Fisher [16], also confirmed that appetite is dependent of on nutrient requirement of the animal and the content of those nutrient in the feed thus, in attempt to meet their requirements for those nutrients, which were limiting with decreasing dietary crude protein levels. Mbajiorgu [17] observed that indigenous Venda chickens increased their feed intake with increase in feed energy level with decrease in feed protein which blamed on genetic limitation [18].

Table 4 shows the amount of feed consumed by each bird in the various treatments.

## Growth performance of indigenous chickens in the confined conditions

The live weight of the chicken at 25 weeks was slightly higher than those reported in Sri Lanka (1516 g) [19] and in Kenya (1800-1964 g) [20].

The differences in the weights reported for the indigenous chickens by different authors may be due to differences in their nutritional history (whether offered protein supplementation or not). Indigenous chickens normally have lower growth rate and mature body weight as compared to commercial growers but with protein supplementation, they might attain improved growth rates. In the current study, live mass of a mature chicken measured up to 2 kg especially those that were fed on high protein level and 1.8 kg in chicken fed on low protein diet. Chickens in the control group grew very slowly. Table 5 below presents the least square means of body weights for chickens on different diets. The body weights in the control group were significantly ($P<0.05$) lower.

Statistically birds continuously fed high dietary protein levels had significantly ($P<0.001$) faster growth rates than those birds in control group (Table 4). This is in line with the result of Jackson et al. [21] who stated that increased dietary protein content result in improved growth performance of chickens. There was a significant difference ($P<0.05$) in growth rate where chicken fed on a high protein diet showed an increase in body weight between the $11^{th}$ and $15^{th}$ weeks while the reverse was the case in chickens fed on low dietary protein level. However, the growth rate of the two groups became similar after week 15. This is an indication in adult birds, that after the completion of ossification period and growth, the effect of dietary CP level on body weight was not remarkable.

Growth is defined as an increase in entire body, body parts or individual organ unit size per unit time [22]. Body growth is influenced by genotype of the birds, by nutrition, tissue specific regulatory factors, as well as other aspects of the feed [23]. Low protein reduces growth as a consequence of depressed appetite and thus reduces intake of nutrients [24]. There is a need to know the actual amount of protein required to avoid wastage.

## Conclusion and Recommendations

Reduction is feeding opportunities due to Flooding in Northern smallholder farming areas communal can be turned into a potential through intensification of indigenous chicken production. However some challenges seem to be real. For example while these indigenous chickens responded to the treatments especially the high plane of protein nutrition rearing indigenous chickens in confined conditions may not be economically feasible. This is due to the fact that the activities of these birds (e.g. chicken behaviors associated with scratching, pecking, fighting, and feed selection) can adversely affect the overall production performance of the birds under confinement. This study recommends that a combination of scavenging during none flood periods of the year be used in combination with supplementation and confined feeding during the flood months. This way, rural farmers will not lose their chickens unnecessarily due to starvation and diseases. Some farmers may do it so well that the flooding challenges may open opportunities for them to intensify indigenous chicken production to the extent of improving their livelihoods or even out right commercialization.

| Dietary level | Feed consumed /bird/week in (kgs) |
|---|---|
| **Control** | 0.163 ± 0.03 [a] |
| **High** | 0.468 ± 0.013[b] |
| **Low** | 0.536 ± 0.013[c] |

The least square means in a column with the same superscript are not significantly different at ($P<0.05$)

**Table 4:** Least Square Mean (± SE) in kg for feed consumption based on different dietary protein levels fed to indigenous chickens.

| Treatment | Regression equation | $R^2$ |
|---|---|---|
| Low | 1.087+0.032X | 0.94 |
| High | 1.199+0.028X | 0.879 |
| Control | 0.725+0.018X | 0.712 |

**Table 5:** Regression coefficients of body weight on age of bird for chickens fed diets of varying protein levels.

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