

Improving the Health and Productivity of the Rural Chicken in Africa: Research and Development Efforts in Tanzania

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Abstract

This paper describes research and development efforts in Tanzania aimed at improving the health and productivity of rural chickens. Scavenging local chickens (SLC) have the potential to contribute enormously to food security in Tanzania once off-take improves. This can be achieved through step-wise improvements in the SLC production system. In Tanzania, Newcastle disease (ND) has been singled out as the most devastating disease of SLC and studies on the thermostability of NDV4-HR, the use of local feeds as carriers for the vaccine and the molecular epidemiology of ND virus have been undertaken. ND extension packages are also being tested.

TANZANIA has a human population of 30 million and land area of 945 000 km². About 80% of the people live in rural areas where the per capita income is low. It has a relatively large livestock and wildlife population. There are about 15.6 million cattle, 10.7 million goats and 3.7 million sheep. There are 11 national parks, 18 game reserves and 56 game controlled areas, which occupy a total of 23.2 million hectares of land (Melewas 1999).

The livestock industry contributes 18% to the gross domestic product (GDP) and 30% of agricultural GDP. About 70% of livestock GDP originates from cattle and 30% from other livestock, including poultry, which contributes about 16% (Melewas 1989a, b).

There are about 400 veterinarians, the majority of whom are employed by government while others are self-employed either as private practitioners or owners of drug distribution businesses. There are more than 1000 paraveterinarians, or animal health

and production technicians who have certificate and diploma level training. There is, therefore, enough qualified manpower to improve the production of poultry in Tanzania, if given adequate financial and other resources.

The poultry industry in Tanzania is not well developed. Although chicken production on a commercial scale started in the 1960s, it has made minimal impact economically and nutritionally. The commercial sector has performed poorly because of the expensive and poor quality commercial feeds, diseases, veterinary expenses, unreliable supply of day-old chicks, and limited credit facilities. As a result, commercial chicken meat and eggs are expensive and consequently consumption is low. Under prevailing economic conditions, the scavenging local chicken (SLC) therefore appears to be a better alternative to the commercial chicken because it requires minimal inputs in terms of finance, manpower and land resources and hence the final product can be made affordably cheap.

However, the SLC has been neglected and limited efforts have been made by government, non-government organisations (NGOs) and farmers to improve their health and productivity. Improved health and productivity of the SLC would have a direct positive impact on farmers' income and nutrition.

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Productivity Indices of the Scavenging Local Chicken in Tanzania

There are 28.3 million poultry in Tanzania, and of these 26.6 million (94%) are the SLCs, while 0.5 million (1.8%) are the commercial broilers and layers and the remaining 1.2 million (4.2%) are other poultry, mainly ducks (3.4%) (MOA 1995).

About 72% of the rural households keep the 26.6 million chickens with an average of 10 chickens per household (Livestock census 1994), although other and more recent studies have reported a higher figure of 23 chickens per household (Mwalusanya 1998).

The productivity indices are relatively low among the SLC. In a study made at Sokoine University of Agriculture in 1989 (Minga et al.) and 1996 (Minga et al.), it was reported that the average adult body weight was 1538 g (range 800–2450 g) and 1864 g (1650–3800 g) for hens and cocks respectively. The average egg weight was 41.8 g with a range of 25 to 56 g. The growth rate under a scavenging system varied from 0.9 g to 30.2 g per day for chicks and growers, but the rate differed depending on age and initial weight. Mwalusanya (1998) reported that the average growth rate from day-old to 10 weeks of age was 4.6 g and 5.4 g per day for female and male chicks respectively. Hens laid an average of 40 eggs per year in three clutches. The average clutch size was 11.8 eggs, and hatchability ranged from 62% to 89%, with an average of 83.6%. Mwalusanya's 1998 study reported that the mean cock to hen ratio was 1:4.3. In another study, Minga et al. (1996) reported the ratio of chicks to growers to adults as 10:5:6, and that might explain the low off-take rate, which is experienced in the sector. The per capita consumption of poultry meat and eggs is 0.7 kg and 13 per annum respectively, while the world average is 6.8 kg of meat and 108 eggs.

Studies have shown that SLC are heterogenous as shown by their phenotypic characteristics. (Lawrence 1998). In Tanzania, Lawrence (1998) identified five ecotypes based on their geographical origin and phenotypic characteristics: Kuchi; Singamagazi; Ching'weke; Morogoro medium; and Mbeya ecotype. The ecotypes differ in several aspects:

- Kuchi from Mwanza region has an adult body weight of 2708 g and 1827 g for cocks and hens respectively, with an average body length of 25.2 cm. The egg weight is 45 g and shank length is 13.3 cm.
- Singamagazi from Shinyanga region with adult weight of 2915 g and 2020 g for cocks and hens respectively, has a body length of 26.4 cm and 22.4 cm. The average egg weight is 45 g. The shank length is 13.9 cm and 10.9 cm.

- Mbeya from Mbeya region has adult body weight of 1621 g and 1394 g for cocks and hens respectively. The ecotype has a body length of 23 cm and 20.2 cm for cocks and hens. The shank length is 12.4 cm and 10.2 cm. The average egg weight is 41 g.
- Morogoro Medium from Morogoro region has an adult body weight of 1850 g and 1107 g for cocks and hens. Body length is 24.2 cm and 21.1 cm and shank length is 12.0 cm and 9.7 cm. The egg weight is 38 g.
- Ching'weke (Morogoro short) from Morogoro region has an adult body weight of 2100 g and 1441.7 g for cocks and hens. Body length is 23.3 cm and shank length is 10 cm and 8.2 cm for cocks and hens. The average egg weight is 37.7 g. Lawrence (1998) reported that immunocompetence as measured by production of anti-sheep red blood cells antibodies did not differ significantly between the five ecotypes. There was no difference between the ecotypes in their susceptibility to Newcastle disease (ND) virus infection and *S. gallinarum* infection except for Kuchi ecotype which survived *S. gallinarum* challenge. Serological MHC typing which was conducted by Lawrence (1998) revealed that it was difficult to do MHC typing of the ecotypes using serological methods which rely upon alloantisera originating from exotic commercial breeds. Lawrence (1998) tested 15 alloantisera with B-F and B-G specificities. Although it was shown that the BF 121 was the most frequent type, it was not specific for any particular ecotype. There were cross-reactions and some chickens could not be typed by using the 15 alloantisera.

In Tanzania, Tibamanya (1994) reported that the SLC takes 108 to 161 days to accomplish one production cycle thus:

No. of Days	Activity
20	Laying 15 eggs per clutch
21	Incubating
60–90	Brooding
7–30	Regaining

Therefore, a total of 108–161 days are required to achieve three production cycles per year and produce a total of 45 eggs.

The Challenges

The big potential of the SLC has not been realised and utilised in Tanzania because of a number reasons. The major reasons are (a) chicken losses through various causes, (b) the low genetic potential, (c) low plane of nutrition, and (d) poor husbandry system which is a low or near zero input extensive

type (Minga et al 1989; Kitanyi 1998). The low input, low output husbandry system is characterised by poor nutrition, poor or no housing facilities, non-selective breeding, no veterinary interventions and lack of provision for rearing chicks.

In an earlier study by Minga et al. (1989), it was reported that the main cause of chicken loss among the SLC occurs during chickhood and averages 50%. The other losses of growers and adult chickens are due to chicken diseases, predators and theft. Chicken loss during adulthood is mainly due to diseases, especially ND.

Loss due to disease outbreaks can be substantial. Whereas commercial chickens are regularly vaccinated against ND, the SLC are rarely, if ever, vaccinated against the disease. In Tanzania, ND has been singled out as the most devastating disease, whereby whole village populations may be decimated. The greatest loss due to ND occurs during the hot and dry season starting from July up to the start of the short rains in October to November. However, sporadic outbreaks do occur in between. (Yongolo 1996). The other infectious diseases, which affect SLC in Tanzania, include collibacillosis, fowlpox, infectious coryza, fowl typhoid and Gumboro disease (IBD) (Minga and Nkini 1986). Parasitic diseases of importance are helminthoses and the ectoparasites, especially fleas and mites (Permin et al. 1997). Fowl typhoid assumes greatest importance among commercial chickens, and frequent outbreaks have been experienced in hatcheries as well as among the commercial layers. Fowl typhoid is economically the most important disease affecting the commercial chicken industry and has a high incidence in Tanzania. (Minga 1986; Mdegela 1998).

The availability of feeds for the SLC is irregular and varying in quality. During the rainy season, there is an abundance of green vegetation, wild grass seeds and insects. Towards the end of the rainy season and beginning of the dry season when grains are harvested, there is abundant supply of grains and kitchen leftovers. During the dry season, however, grain supplies dwindle and insect populations decline. There is very little feed supplementation. Rarely are the SLC fed on whole grains but rather spoiled grains and the brans which are left over after milling the grains. Such erratic feed supply cannot be expected to sustain high chicken productivity levels. It has been estimated that the SLC feed consumption provides to the chicken only 11 kcal metabolisable energy and 11 g of protein per day, and that amount of feed is inadequate for optimal productivity and below what is needed for maintenance (Kitanyi 1998).

Mwalusanya (1998) reported that the main components of crop contents of SLC were cereal grains,

bran, green forages, insects and worms. The chemical composition of the crop contents were: 43% dry matter, 10% crude protein, 5.8 crude fibre, 12.5% ash, 0.66% calcium and 0.4% phosphorous.

Research

In Tanzania, some limited research has been conducted:

- Crossbreeding experiments (MSc and PhD theses).
- Prevalence of diseases among SLC has been studied, but mainly ND, Fowl typhoid and helminthoses. (Papers and MSc and PhD theses).
- Some ecotypes have been identified and disease resistance has been studied on a small scale (MSc thesis).
- Studies on productivity and nutritional status of the local chickens under village management conditions (MSc dissertation).
- The molecular epidemiology of fowl typhoid (MSc dissertation).
- The thermostability of the NDV4-HR vaccine at room temperature and efficacy (results are contained in the country report of these proceedings).
- Studies on the use of various local feeds as carriers for the NDV4-HR vaccine.
- Studies on the molecular epidemiology of ND virus are in an advanced stage.
- Molecular typing of the SLC ecotypes in Tanzania is in an advanced stage.
- A study to determine the value of the traditional medicinal plants in the treatment of chicken diseases.
- Studies on flock dynamics; more research is planned.
- Nutritional studies (Part of an MSc dissertation).
- Crossbreeding programs using hybrid cockerels as an extension package.
- NDV4-HR and I-2 ND vaccination extension packages have been tested and are continuing to be tested (reported in the country report of these Proceedings).

The Way Forward

It has been shown above that the productivity indices of the Tanzanian SLC are low. The ratio of chicks to growers to adults of 10:5:6 shows that 50% of the chicks hatched are lost before reaching adulthood. Chick loss is due to diseases, poor husbandry, and predators. The cause and magnitude of the loss, which occurs among growers and adult chickens, has not been precisely determined in Tanzania. Unpublished observations indicate that the loss which occurs when chickens have reached the grower and adult age is lower than in chicks. However, there is

periodic loss of adult chickens mainly due to infectious diseases, especially ND.

Surplus chickens available for disposal are few because of the off-take rate which is very small. The number of eggs produced per chicken per year is very low. The size of the egg and of the adult chicken is small. It was previously thought that the zero input extensive husbandry system which the SLC are subjected to cannot be expected to have any meaningful out-put. However, during the 1998–99 drought which affected some parts of Tanzania, it was realised that livestock plays an important role in food security when livestock were sold to get cash to purchase food grains. Therefore, the SLC has the potential to contribute enormously to food security once the off-take improves. It was stated by MacGregor and Abrams (1996) that 12 laying hens per household would reduce the incidence of malnutrition in the resource-poor households.

The constraints experienced by the SLC sector must be solved in order to increase the production of the SLC. Once those constraints have been tackled, the chicken population will increase, off-take rate will increase, which could then be translated into better income and nutrition of rural people. A moderate increase of off-take would easily be accommodated by the current level of the economy and will force prices down. Experience in Tanzania shows that SLC meat is preferred to the commercial chicken meat on account of their perceived better taste and lack of residues, especially hormones. There is thus a good market for the SLC in urban areas in Tanzania. Preliminary results of a market survey in Morogoro, indicates that there is a big market for SLC in urban areas. The number of scavenging local chickens transported to Dar-es-Salaam and Morogoro using the Dodoma highway is being collected at a traffic police checkpoint near Morogoro town.

So far, data for two months (January and February) have been collected and the following are the preliminary results:

<i>Destination and month</i>	<i>Average number of chickens transported per day</i>	
	<i>January</i>	<i>February</i>
Dar-es-Salaam	430	304
Morogoro	114	108
Total	544	412

Hence, the expected number of chickens to be transported for 12 months is for Dar-es-Salaam 133 955 chickens and for Morogoro 40 515 chickens.

The average price per chicken in Dar-es-Salaam is 2150 shillings, therefore total estimated sales in

Dar-es-Salaam for one year would be 288 003 250 shillings (US\$360 004).

The average price per chicken in Morogoro is 1300 shillings, therefore the estimated total sales per year in Morogoro is 52 669 500 shillings (US\$65 837).

Therefore, figures indicate that even when no intervention has been done to improve the health and productivity, the contribution of the SLC industry to the economy of the country is substantial.

Improvement in Production

The potential of the SLC in Tanzania may be gauged by using a simple model which is based on an assumption that chicken loss can be kept to a minimum, which is a difficult ideal to achieve, but possible if major diseases are controlled.

It has been stated above that in Tanzania, the chick, grower, adult ratio is 10:5:6 which means, of the 26.6 chickens, there are 12.7 million chicks, 6.3 growers and 7.6 adults. Assuming a cock to hen ratio of 1:4 (Mwalusanya 1998), the hen population is 6.08 million. If in an improvement program chick loss is reduced to 10%, then after one year, there will be 11.43 million growers. Assuming a grower loss and replacement will take 2% of the growers, the surplus will be 11.2014 million adults. The value of the surplus chickens will therefore be 16 802 100 000 shillings (US\$21 002 625). With sustained disease control efforts, the ratio of chick to grower to adult will be 37:29:1. This is based on the assumption that one hen would lay 45 eggs per year which will have hatchability of 83%. The chick loss will be at 10%; egg consumption, and grower loss and replacement of parent adult chickens will be 2%. Hence, the ratio will be 30:29:2 for chick, grower and adult chicken.

The total chicken population has been estimated to be 26.6 million, a figure obtained by using a questionnaire. We have learnt through experience that farmers do not include chicks when giving population figures but rather count only growers and adults. On that assumption then, the adult population might be 13.3 million (half of 26.6 million), and of these 4 in 5 would be hens and hence 10.88 million hens. By that argument, if disease is reduced to 10% and 2% chick and grower loss respectively, and ratio is 30:29:1 (chick:grower:adult), those hens would produce a progeny of 315.52 million adult chickens per year worth 473 280 000 000 shillings (US\$591 600 000) equivalent to 4 930 000 head of cattle. That ideal is unlikely to be achieved, but if it were to be achieved the domestic market would be unable to absorb it and alternative marketing strategies would have to be worked out. These figures are meant to emphasise the

importance of the SLC. It could be a big industry, especially where biologically farmed animals and their products are preferred.

One big constraint which hinders the expansion of the chicken population is feed. Improved feeding regimes for SLC are constrained by shortage of the main ingredient in chicken feeds, which is food grains such as maize. As Sonaiya (1995) stated, where there is no self-sufficiency in food grain production, there will be scarcity of alternative feed-stuffs for compound feed or other locally produced feeds.

In order to realise this big potential in Tanzania, it would require improvement in husbandry, nutrition and increased grain out-put and disease control strategies, but with minimal financial input. Such improvement must be made cost-effective and sustainable. Chick loss must be minimised through better husbandry practices and chickens should be protected from the scourge of ND. Husbandry practices that would minimise the rearing time for chicks would also greatly facilitate the quick build-up of the chicken population.

Improvement of Genotype

The great variation in egg weights, growth rates, adult weight and the lack of MHC typability, as well as the presence of five ecotypes indicates that the SLC in Tanzania is phenotypically and genetically heterogeneous. The phenotypic and genetic heterogeneity and the indication of disease resistance emphasises the biodiversity of SLC and hence SLC are a rich source of genes ideal for selection, breeding and multiplication of the most suitable ecotype which would be most adapted to the local condition. The same was pointed out by Horst (1988) who stated that the genetic resource base of the indigenous chicken in the tropics is rich and should form the basis for genetic improvement and diversification to produce a breed adapted to the tropics. The preservation of the indigenous chicken germplasm and biodiversity was advocated by Bessei (1989).

Programs aimed at improving the health and productivity of the SLC ought to be sustainable in order to have lasting impact on the income nutrition and health of target rural human population (Kitalyi 1998). Kitalyi recommended a step-wise improvement of the SLC production system, and which I would also like to advocate:

- Step 1: Improve hygiene, shelter, preferential treatment of chicks and control of devastating diseases and hence end up with healthy SLC.
- Step 2: Improve management of SLC through supplementary feeding, better housing and

disease control program and formation of farmers group.

- Step 3: Improve SLC productivity through selective breeding, for high yielding traits and for disease resistance. Improve feeding and marketing and formation of producer-consumer associations. Encourage vigorous promotion of the consumption of chicken meat, eggs and chicken products in urban and rural areas. Increased consumption would then create increased demand and thus sustain and promote improved chickens and increase SLC production. In turn it would add to food security, increased income and better nutrition and health for the resource-poor rural populations.
- Step 4: Commercial village chicken production system: Multiplication and distribution of high-yielding SLC types. Promotion of improved and competitive marketing strategies.

Research and Development

There are many areas of research which are unexplored or have inadequately explored the potential of the SLC:

1. Husbandry:
 - Production: Factors affecting production.
 - Nutrition: Assessment of nutritional status of the SLC.
 - Feeding: Optimal feeding regimen using locally available feed ingredients
 - Shelter: Development of appropriate shelter using local building materials.
2. Population dynamics, Genetics (Genotyping), Breeding (Genetic improvement) and multiplication of improved ecotype/haplotype.
3. Infectious and non-infectious diseases: Epidemiology and control.
 - Collection of baseline data, susceptibility trials, disease resistance testing of ecotypes, vaccination trials and treatments.
4. Socio-economics: including gender issues, land, time allocation.
5. Marketing: Optimal marketing strategies.
6. Extension packages: Intervention technologies, development and application.

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