

1. General introduction

Poultry production constitutes of smallholder rural and commercial urban production in Malawi. In 1998 the poultry population was estimated as 11.5 million (Malawi Government, 1999a). The rural poultry sector forms the largest component with more than 80 % of the poultry population. Chickens constitute the majority (83 %) followed by pigeons (14 %) and ducks (2 %). Other species include turkeys, geese and, currently into domestication, guinea fowls. Most of these are indigenous¹ except in chickens where traces of the Black Australorp (BA) breed can be found. These BA chickens were introduced to cross breed with local chickens (LC), a program that has been in practice for over 40 years, with a goal to improve productivity of the LC (Malawi Government, 1999). In most households, women and children are caretakers of traditional poultry kept on free-range extensive system, a practice common in most African and Asian countries (Aini, 1990; Dessie and Ogle, 1996, Kitalyi, 1997; Aganga et al., 2000). Rural poultry (chickens in particular) is widely and equitably distributed among households that even the more poor and marginalized in societies own them. The urban sector, on the other hand, comprises of commercial chicken production, mainly for egg and broiler production, raised under intensive system and using exotic layer and broiler strains. Because of high cost of production due to feeding and capital inputs, urban poultry sector constitutes less than 20 % in Malawi and other developing countries (Safalaoh, 1997; Gueye, 1998).

Corresponding with human population and status, rural poultry sector forms an important component of human livelihood and contributes significantly to food security. LC offer broad spectrum of uses to the majority of Malawians. They are an inexpensive animal food (meat and eggs) and income to most resource poor rural people. Socio-cultural contribution includes slaughters to a welcomed guest, in marriage and funeral ceremonies, and in settling disputes in traditional courts presided by chiefs (Gondwe et al., 1999a). Their small size and fast reproductive rates allow easy conversion into food and money that, for example, women in households can manage without waiting for decisions from husbands. Rural poultry can therefore be used to empower women and marginalized groups socially and economically. LC production is an important component of livestock in the rural societies.

As in most developing countries, LC, interchangeably called village, traditional or rural chickens, are generally considered to be genetically producing low quantities of meat and eggs, are raised under free-range and survive on scavenging. LC are usually sidelined and considered a secondary occupation to other agricultural activities in households. This makes LC to be raised with minimal input and thus produce the output cost effectively (Aini, 1990). In Malawi, this generalisation led to introduction of exotic dual purpose BA chicken to cross breed with the LC as a breeding strategy to improve their performance (Upindi, 1990). The primary goal was to improve meat and egg production from the BA while getting adaptive features from the LC by exploiting heterosis displayed in crosses. Distribution of six-week old BA chicks from three government breeding stations (Mikolongwe, Bwemba and Choma) was initiated to smallholder farmers in the three administrative regions of

¹ Indigenous in this document shall imply local to the area, has lived with the people, breed and survive under adaptation from human and physical environment, management and breeding practices. The term also distinguishes local from other recently and purposely-introduced breeds so called exotic. Terms indigenous and local will be used interchangeably throughout the thesis.

Malawi, namely, the South, Centre and the North, respectively. The program however, lacked strategies to monitor implementation procedures and benefits (Safalaoh, 1992). It appears to have failed meeting the objectives but continues (Safalaoh, 2001).

The failure of the BA x LC cross breeding program is due to several factors and associated production constraints. The BA breed was introduced into the country without evaluating the breed under prevailing local conditions (diseases, low and erratic feed base, temperature, rainfall pattern). Production environments and systems, available genotypes, farmers' goals and functions of species were overlooked, as was the case for most developing countries, where such programs were implemented (Timon, 1993). BA were introduced into LC flocks that were non-characterised in terms of their production and husbandry practices. To establish a working base for present and future programs, there is need to carry out such studies under existing production systems if reliable information regarding their performance potentials and extent of benefits to get from any breeding program are to be achieved.

Studies on LC production, characteristics and their scavenging production systems are few and mostly done in northern Malawi (Ahlers, 1999; Hüttner et al., 2001). Yet scavenging is the sole system of raising LC. Meaningful development of genetic and non-genetic improvement programs requires valid scientific information but might be unsuccessful and unsustainable if failing to apply a holistic approach. For such programs to be initiated there is need to generate adequate information on production and reproductive parameters, husbandry practices, growth physiology and constraints under the prevailing environment. The current proposed study seeks to characterise chickens through research and monitoring.

The work on poultry is chosen because most rural people raise LC (Malawi Government, 1994). With the current land declining rate (average farm size estimated at less than one hectare per household), keeping of large species of livestock such as cattle is not viable to majority in rural areas. LC has potential to contribute to nutrition, poverty reduction, social, cultural, gender and household equity in rural areas. All previous studies, though not fully conclusive, show that the species has potential for improvement requiring definition of entry points and determination of levels for improvement.

In almost all past programs, especially in research, there has been virtually little or no farmer participation. This is particularly due to the fact that most research were on-station oriented, based on fewer demands than anticipated by researchers (Werner, 1993). Local knowledge of farmers remained untapped and farmers were receiving extension messages as prescriptions in a top-down system. In most cases such messages had problems of adoption or were not fitting into the farming systems and goals, and lacked feeling of ownership by farmers, leading to unsustainable development efforts. Involving farmers means they should participate in developing and implementing research and programs from the beginning (exploratory phase). This approach motivates farmers and provides incentives to developmental oriented research, enables proper understanding of the environment (both social and physical) into which animals will fit and allows programs to be tailor-made for their success and sustainability. The proposed study seeks to address this through a community based systems research approach.

The problem statement

Review of literature has shown that rural chickens have potential food and non-food contribution to human livelihood, especially in smallholder rural communities. Rural chickens have also been asset starters for most poor (vulnerable) groups in societies. Genetic and non-genetic factors and their interaction contribute to their potential and diversity; hence both management and breeding strategies could be used to improve productivity in rural chickens. The problem is that proportions and extent of each component (genetic and non-genetic) are currently not known. Priorities on strategies also depend on target groups, their goals and objectives, their socio-economic status and current production potentials, bearing in mind sustainability of programs. All these can only be identified and properly designed after thorough characterisation of the species within the context of their farming systems and farmer participation.

General hypothesis

Phenotypic variation in production and reproduction performance traits exist in local (indigenous) chickens in Malawi that provides potential to improve their productivity and contribution to food security through genetic and management strategies.

Objectives of the study

General

To evaluate phenotypic and genetic characteristics of local chickens, and their production system for sustainable utilisation, improvement and conservation of the species in a low-input crop/livestock mixed farming integrated system.

Specific

- i. to characterise the low-input production and marketing systems and potential for LC
- ii. to evaluate productive and reproductive parameters for LC under scavenging conditions
- iii. to compare productive and reproductive performance of the species raised on-station and those evaluated on-farm under scavenging system
- iv. to evaluate growth potential and nutritional parameters of local chickens
- v. to determine efficiency of LC production system and to value flock output
- vi. to compare growth performance of BA and LC under scavenging conditions
- vii. to estimate genetic parameters for production traits for LC on free-range

2. Literature review

2.1 Origin and evolution of chicken domestication

There is conflicting information about the actual centre and time of domestication as well as ancestors of the domestic chicken. Horst (1989) reported that all domestic fowls originated from small jungle fowl (*Gallus gallus*) of South-East-Asia. Crawford (1990a) reported that chickens were domesticated from the red jungle fowl in the Indus valley about 2000 B.C. West and Zhou (1989) also mentioned domestication in India around 2000 B.C. but reported that chickens were first domesticated from red jungle fowl in South-East-Asia well before the sixth millennium B.C. These authors concluded that the red jungle fowl was a convincing ancestral wild form of the domestic fowl, commonly called chicken, unlike the other two species *Gallus sonnerati* and *Gallus lafayettei* that other authors previously reported on. All above authors derived their evidences from archaeological, vegetation, climatic and geographical information. Through DNA fingerprinting, Siegel et al. (1992) further verified the red jungle fowl was an ancestral form of the domestic chicken.

From the original centres, chickens, as other livestock species underwent domestication and migration processes. Diamond (2002) defines domestication as breeding a species in captivity and thereby making the species modified from its wild ancestors in ways making it more useful to humans who control its reproduction and food supply. This process led to evolutionary changes in domestic species in such a way that they started differing in morphology, physiology and behaviour from their wild forms. While in domestication, chickens underwent selection and migration (Horst, 1989; Crawford, 1990a; Diamond, 2002). From these centres of origin, migration of chickens followed an east-west axes pattern of other livestock, rather than a north-south axes pattern. According to Diamond (2002) similarity of latitude led to species sharing same day lengths, seasons, climates, habitats and diseases that made them to require less evolutionary changes than do locations at different latitudes. The north-east-west migration pattern of chickens is clearly reported by authors unlike to migration and domestication process in Africa. Crawford (1990a), Marle-Köster and Casey (2001) and Tadelle (2003) reported that chickens may have come through Egypt to Africa during the iron age period. Marle-Köster and Casey (2001) stated that East Africa-Indian traders and European settlers most probably introduced domestic chickens to Southern Africa. Crawford (1990a) reported that origin of chickens from India to East and West Africa was more likely because of a well early-developed trade between India and east coast of Africa.

Crawford (1990b) reported that the initial purpose of domestication of chickens was first for cock fighting, then religious and cultural. During this time, selection was based on feather colour and morphological variants. Only much later did man begin to use domestic chickens for food. Following domestication and migration east-west, major evolutionary changes took place in chickens due to intensive artificial selection for traits of economic importance in the west (Siegel et al., 1992). This led to developing a

specialised meat-type and egg-type commercial stocks after the 1950s (Crawford, 1990b). The selected and improved breeds, however, reduced genetic variation, became more similar to each other but became distanced from their jungle fowl ancestor, unlike the unselected non-commercial chickens (Siegel et al., 1992). The later constituted the generally called local or indigenous chickens common in Africa and other developing countries (Horst, 1989). On the other hand, high yielding fowls are now used worldwide (Crawford, 1990b).

There is no information on origin of domestication of chickens in Malawi. According to Crawford (1990a), local chickens were found in Mozambique by 1600. Since these share borders, it may be reasonable to speculate that chickens were domesticated in Malawi by that time. Southern and eastern routes could be probable entry points of chickens to Malawi.

2.2 Poultry production and importance in Africa

Poultry production in Africa follows the status of other developing countries in Asia (Aini, 1990) and Latin America (Kyvsgaard et al., 1999). Poultry in Africa is skewed towards chicken production (Branckaert and Gueye, 1999). In 2003, chicken population in Africa was estimated as 1.3 billion, with Nigeria, Morocco, South Africa and Algeria producing over 120 million chickens each (FAOSTAT, 2004). In Sub-Saharan countries excluding South Africa (SSA), aggregate chicken population was 775 million. In Africa, 3 million metric tonnes of meat were produced, of which 1 million came from SSA countries excluding South Africa (FAOSTAT, 2004). Kleyn (2004) reported that poultry production in Africa increased by 60 % between 1995 and 2000. Kleyn (2004) further reported that little poultry meat is exported, and, if any, mostly to other African countries.

Production is demarcated into two sectors, the commercial, high input-high output sector and the rural, village sector. The commercial sector follows '*all in-all out*' intensive production of meat (broilers) and eggs (layers), uses high yielding strains bred and supplied by international breeding companies. Due to need for high capital and inputs, skilled management and markets, commercial sector is often restricted to urban and peri-urban areas or markets in SSA.

The village poultry sector is synonymously called traditional, rural, scavenging, family, indigenous or extensive poultry production. These terms basically summarise the characteristics of poultry produced and their production system. As described by several authors, traditional poultry is basically chicken production; is an almost omnipresent activity among smallholder farmers in the developing world; stems from traditional practice throughout Africa; and is raised with minimal input under free-range, scavenging system (Gueye, 1998; Branckaert and Gueye, 1999; Kyvsgaard et al., 1999). Gueye (1998) reported that nearly 80 % of chicken population in Africa, as in Asia (Aini, 1990) are predominantly indigenous breeds raised under extensive system. Since these chickens are maintained with very low land, labour and capital inputs, even the poorest social strata of the rural

population keep them. While the commercial sector has high and specialised output, the traditional chicken has low productivity, with diversified output and a complex of constraints such as high mortality in chicks, disease, parasites, predation and poor feeding. Village chicken production follows a route of '*production by the masses*' since they are raised in small flocks sizes of 5 – 20 or more but by the majority rural masses (Panda and Mohapatra, 1993; Gueye, 1998). Village poultry production is generally known as a sidelined sector among smallholder farmers. Women and children are mostly caretakers. By following traditional practices of production, this village poultry has been a component of small farms for centuries and is assumed to continue in the foreseeable future in Africa and Asia (Ramlah, 1996; Branckaert and Gueye, 1999).

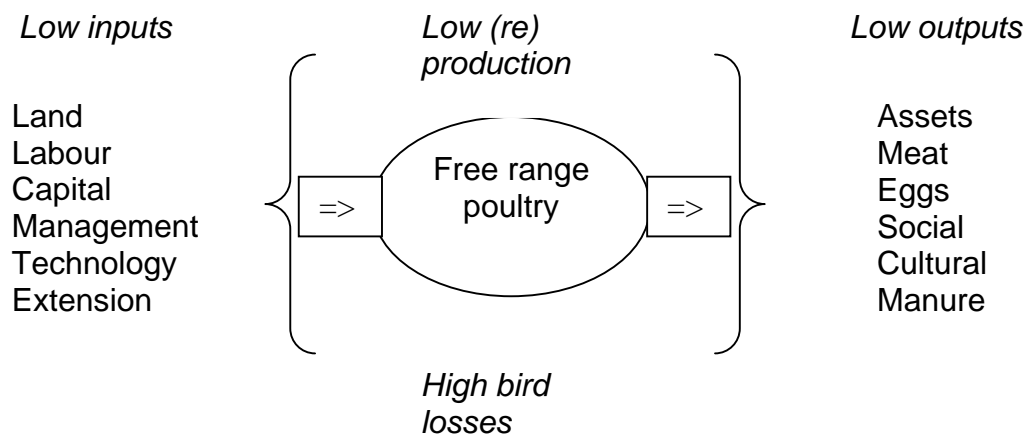
Importance of chickens in all societies include source of protein food, income, use in traditional and religious ceremonies, among others. Order of importance of each function, however, differs between countries and societies as reported by several authors. For example, Dessie and Ogle (2001) reported equal importance of functions of chickens in terms use for sacrifice, sale and consumption as perceived by farmers in Central Highlands of Ethiopia. Ekue et al. (2002) reported that main functions of local chickens among farmers in Cameroon were to sell for income and as source of food. Missohou et al. (2002) reported that farmers used chickens mainly for household consumption and only few sold their chickens to earn income in Southern Senegal. Despite differences in order of importance of roles local chickens play to rural communities, multifunctional use of local chickens was obvious.

2.3 Rural poultry production and breeding systems in Malawi

2.3.1 Free-range (extensive) system

Free-ranging is a popular terminology in Malawi that relates to smallholder sub-sector livestock production system in rural areas. In the case for poultry, birds are let free in the morning and they roam around the homesteads looking for feed through scavenging. Most feed scavenged and the quantity is not known and there is also little information from research on scavenging. However, farmers may supplement the birds, usually at irregular intervals with left over from human food and by-products from food processing (Safalaoh, 1997). Feed supplementation is not standardised and depends on periods of food availability to households (Ahlers, 1997; Gondwe et al., 1999a). Other production factors of free-range system are not properly documented but follow similar production systems for chickens reported in almost all countries in Africa (Minga et al., 2000; Tadelle et al., 2003a) and elsewhere (Huque et al., 1999). National reports by Upindi (1990) and Kampeni (2000), and review studies by Safalaoh (1997) show that local chickens produce in a low-input low-output system illustrated in figure 2.1. Birds from different flocks and of different age-groups scavenge together. Major capital investment is the procurement of breed stock, using cash or non-cash traditional stock sharing systems (Gondwe et al., 1999a), and where done, construction of night shelter

(locally called *khola*). Most likely and in general contribution of external inputs is insignificant.



Source: Diagram based on several country and technical reports

Figure 2.1. Low-input, low-output relationship in rural poultry production systems

National and technical reports have documented several disease related constraints to rural poultry production in Malawi (Christensen, 1986; Upindi, 1990; Kampeni, 2000).

2.3.2 Breeding systems

Breeding programs in rural areas define breeding activities carried out by communities at subsistence level, considering their production environments, breeding goals and objectives, selected traits and mating methods (Sölkner et al., 1998). Village breeding programs usually include food, ecological conditions, economic and social benefits of livestock, while at the same time being risk conscious. It requires understanding these factors in order to incorporate and exploit traditional breeding programs.

Unplanned random mating is practised in chickens within flocks and between flocks that scavenge together. Traditional breeding systems exist (Gondwe and Wollny, 2002) but have not been documented in details. Farmers exchange breeding stock with other farmers in traditional stock sharing systems and this goes with preference for particular phenotypes (Ahlers, 1997). Gondwe et al. (1999a) observed that sharing breeding stock is more often between members within the village than between members outside village households (Table 2.1). In similar studies, there appeared to be a declining trend in proportion of cockerels in flocks with age while breeding hens stay in flocks for long periods of over two years. Gueye (1998) reported that on village fowl flocks, males are generally removed from flocks at an early age for sale, home consumption or for cultural purposes. Keeping hens for long reproductive periods may indicate their preference for reproduction (Sölkner et al., 1998).