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Australian Centre for International Agricultural Research

# Final report

Small research and development activity

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# Contents

# 1 Acknowledgments

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Finally, we would like to give thanks to all the farmers, traders and other member of the poultry value chain in Myanmar for their willingness to participate in this research.

# 2 Executive summary

Over the past few years, the demand by consumers for poultry meat in Myanmar has increased dramatically. Rises in urbanization, incomes and population size are significant factors in this trend. However, the supply of indigenous chickens is often inadequate to meet consumer demand due to reliance on normal village extensive production methods, i.e. natural mating with egg incubation under broody hens, and the very high attrition rate in young chicks. In addition, the performance of birds is limited by the extensive management involving either significant reliance on the birds' ability to forage for food in the environment and/or limited feeding of grain or poultry feed, often with widely varying nutrient composition.

Intensive/semi-intensive indigenous chicken production has a great potential to provide small-scale farmers with additional business opportunities, because 1) indigenous chicken are sold at premium prices that are often up to four times that of broiler chickens, 2) indigenous chicken are the preferred poultry meat for consumption, 3) indigenous chicken are raised sustainably under free-range conditions without the use of antimicrobials, and 4) indigenous chicken are in high demand because of the increased health consciousness of consumers.

The small-research and development activity reported here focused on identifying opportunities for diversifying indigenous poultry production by developing an intensive/semi-intensive indigenous chicken production system that can be adopted by a significant proportion of small-scale farmers (in particular women), across the whole country. The research was based on preliminary activities that commenced in the ACIAR funded DAHAT PAN project (AH/2011/054).

A number of research studies were conducted. Firstly, we carried out experiments to compare the effects of commercial diets varying in protein and energy, upon the growth rate and feed efficiency of indigenous chickens reared intensively. Secondly, we conducted field experiments on semi-intensive indigenous chicken rearing, which included designing and testing the infrastructure required (enclosures and sheds) for raising indigenous chickens semi-intensively and measuring the chickens' growth performance under diets developed for semi-intensive rearing. Furthermore, we performed a cost-benefit analysis focussing on comparisons between a) semi-intensive/intensive rearing, b) scavenging rearing with improved chick management, c) scavenging rearing under traditional conditions and d) commercial broiler production. In addition, we identified opportunities and constraints for breeding, feeding, trading and marketing (e.g. live bird sales, sale of slaughtered birds and value-added chicken products) of indigenous chickens raised under intensive/semi-intensive conditions. We also conducted a value-chain analysis to describe the retailing channels for indigenous chickens.

The feeding trials demonstrated the potential of intensive production of indigenous birds to be economically viable given appropriate diets. The data obtained clearly demonstrated the value of intensive housing and feeding of young chicks in minimizing the attrition rate (to less than 10%), which has a profound impact on the economic viability of production. However, more work is required to define optimum nutrient composition and marketing age. We were able to develop an appropriate design for semi-intensive rearing facilities using local, sustainable and affordable materials, but we also identified a key challenge for semi-intensive rearing: chicks for semi-intensive (or intensive) rearing were not readily available. This highlights the need to establish breeding farms for indigenous chickens, from where farmers are able to purchase birds for semi-intensive or intensive rearing.

In the cost-benefit analysis, we were able to show that under the intensive/ semi-intensive system calculations, maintenance energy requirements increased linearly with age up to the normal market weight of 0.8 viss (or 1.3 kg) liveweight. This caused food intake and FCR to increase commensurately, which resulted in a substantial increase in food cost. The impact of variation in sale prices ranging between 5,000 to 6,500 kyats per viss demonstrated that sale returns minus feed and day-old chick costs, decreased but were still positive for growth periods up to 133 days at a sale price of 6,500 Kyats per viss, but were negative at growth periods in excess of 80 days when sale prices were at 5,000 kyats/ viss. It is thus essential where sale prices are low for birds to be given high nutrient spec diets and to grow rapidly to achieve profitable results. The quantum of returns over variable costs for different flock sizes demonstrated that even with a flock size of only 500 birds, annual returns were in excess of 2 million kyats with a growth period of 70 days and a sale price of 6000 kyats per viss. In contrast, extensive rearing of a standard flock size of 30 birds, was calculated to generate annual returns of around 197,000 kyats per year under scavenging rearing with improved chick rearing (as promoted in the DAHAT PAN project) versus 66,000 kyats under the traditional

extensive scavenging system. Furthermore, commercial broiler production can also provide reasonable annual returns to farmers, but due to the lower and more fluctuating sale prices of broilers compared to indigenous chickens, there are potential business uncertainties associated with broiler production.

The value-chain analysis highlighted that semi-intensive production provides a profitable opportunity, but more research is required to facilitate the development of procedures aimed at i) maintaining a consistent supply of birds to farmers, ii) providing a cost-effective feeding program for indigenous chickens which optimises growth and feed efficiency, and iii) developing a more direct and practical marketing strategy for indigenous chicken products. Our research also indicated that some localised examples of diverse marketing strategies for high-value indigenous chicken products (fried village chicken') already exist, with opportunities for further expansion. Our research identified that the high demand for indigenous chickens by customers frequently can't be met by birds currently produced under extensive conditions, highlighting opportunities for increased production and better marketing of indigenous chicken. Overall, there was a strong interest by farmers and traders in increasing and diversifying indigenous chicken production, but a need for training and support was indicated.

In summary, this research has demonstrated the importance of achieving good growth performance from the birds in order to achieve good profitability from intensive or semi-intensive production of village chickens. It is acknowledged that optimal economic performance from these birds, as a consequence of their considerably lower genetic potential for growth, than broilers, may be achieved on diets with lower nutrient specifications than commercial broiler diets. However, considerably more work is required to define the nutrient requirements of these birds and hence to develop optimal diets to maximise economic performance. The project generated a unique dataset and methodology that provides an opportunity to develop a semi-intensive production system that can be adopted by a significant proportion of small-scale farmers with limited resources, in particular women. Such an enterprise offers a distinct opportunity for a first step out of poverty. Veterinary service providers and animal feed and health product and vaccine suppliers will also be important beneficiaries of semi-intensive indigenous chicken production. As village poultry production plays a vital role in the livelihoods of traders, middle-men and sellers of poultry products in rural communities, semi-intensive indigenous chicken production could increase their trade volume and income. Thus, under the one-health paradigm, rural food and nutrition security could be maximized through increased numbers of chickens and eggs available in rural communities and through increased trade in peri-urban and urban communities.

There are a number of factors which determine the potential viability of intensive and semi-intensive chicken production and which need to be considered and further researched. These include breeding and genetics, housing and nutrition, quality and availability of poultry feed, and marketing of birds.

# 3 Introduction

Poultry keeping by villagers in many developing countries such as Myanmar, is very traditional and has its roots in ancient cultures. Not only do the birds supply the family with meat and eggs for home consumption, but they are a resource that can be sold to provide cash to purchase household items and other food or pay for the educational needs of the children. Additionally, chickens and eggs are widely used in many traditional and religious ceremonies, can be given as gifts to honoured guests and the birds are active in pest control and produce manure for use as a fertilizer. A particularly desirable feature of smallholder poultry keeping in comparison with other livestock keeping/farming is that women are generally responsible for looking after the poultry flock. This empowers women and translates into better nutrition and greater educational opportunities for the children, particularly where productivity is improved through poultry production improvement programmes.

In the rural regions of most developing counties including Myanmar, the large majority of families keep a small household scavenging poultry flock of between 1 and 50 birds; mostly indigenous breed chickens, but sometimes other avian species including ducks, turkeys and quail. These 'village' poultry constitute about 80% of poultry stocks in the country, thus contributing considerably to livelihoods of rural families.

The village hen is for the most part a very effective incubator and brooder. She will typically lay a clutch of between 10 and 14 eggs and sit on these to hatch between 8 and 12 chicks, with a typical hatchability of 75 to 85%. Whilst it is commonplace to see a hen scavenging in the village environment with up to 10 or 12 baby chicks not long after they have hatched, it is rare to see a hen with more than 4 or 5 chicks once they have reached about 6 weeks of age. This typical attrition rate of between 50 and 80% is due to the effects of malnutrition, disease, predation and climatic exposure and is undoubtedly the greatest single factor limiting the impact of poultry keeping on household food security and income generation.

Mortality in older birds is also often quite high, due principally to the effects of disease with a lesser impact of malnutrition and predation. It is generally recognized that in the absence of effective vaccination programmes, Newcastle disease (ND) frequently accounts for a high proportion of the disease-related deaths, but other diseases such as avian influenza, fowl pox and fowl cholera are also involved in significant losses at times.

The typical annual egg production of indigenous breed hens ranges from about 40 to 100 with an average around 60, compared to commercial layers at about 300. This very large difference, however, needs to be seen in the context of the different physical and nutritional environments under which the birds are reared, and to take account of the fact that the village hen spends a very significant proportion of the year (65–75%) hatching the eggs and rearing the chicks, during which time she is out of lay. Having said this, even when these birds are placed in laying cages and given ad libitum access to good-quality layer diets, their laying performance is significantly lower than commercial layers. This has particular ramifications for farmers contemplating intensive egg production using indigenous breeds to capitalize on consumer preference for the eggs from indigenous hens; the premium paid for their eggs must be very considerable to compensate for their much lower level of production.

Typical growth rates of indigenous birds are also much lower than that of commercial broilers, even under ideal management and feeding conditions. Under village conditions, male birds that are surplus to breeding and cock fighting requirements are typically sold at between 15 and 20 weeks of age weighing between 800 and 1200 g. The preference for indigenous poultry meat expressed not only by rural communities but also by a significant proportion of urban and peri-urban dwellers is related to the older, firmer and more flavoursome meat from the indigenous birds, which is more suitable for traditional forms of cooking than broiler meat.

The scavenging system means that feed costs are eliminated or dramatically reduced in comparison with intensive forms of production. The impact of this on productivity depends on the nature of the scavenging feed resource base (SFRB) and the level of supplemental feeding. The latter, however, is usually quite limited and typically restricted to household food scraps and small amounts of rice or maize or their by-products. The SFRB includes plant seeds and fruits, grain, earthworms, snails, frogs, insects etc., and is influenced by geographic location, local vegetation and microclimate, physical restrictions on the scavenging area, the poultry and other scavenging animal population density, as well as season. In most cases, the SFRB is limited, which restricts the overall effective scavenging poultry population.

The requirement to scavenge means that the birds are typically not confined in enclosures and are free to range and forage, at least in the daytime. In many cases housing for night-time protection can be very rudimentary or even absent, in which case the birds roost at night in trees or on buildings. Shelters, if provided, range from in or beneath the family's home or in the houses/barns of other livestock, through rudimentary poultry houses built from locally sourced materials, to more sophisticated housing providing shelter from the elements and reasonable security from predators. In nearly all cases, the cost and sophistication of housing is very much lower than used in the more intensive production systems. Night-time predation and theft are often important sources of loss in young chicks and adult birds respectively, so secure night-time housing is an important element in reducing losses.

There are a number of reasons why indigenous breed poultry rather than commercial broilers or layers are used almost exclusively in scavenging production systems : Indigenous breeds have retained the capacity to go broody and thus are capable of hatching their own eggs and reproducing the flock, something that commercial broilers and layers have not ; whilst productivity under confined rearing and high level feeding is much greater in commercial breeds of broilers and layers than in indigenous breeds, under village scavenging conditions, commercial birds perform very poorly due to much higher nutrient requirements and lack of adaptation to the typically harsh environment; due to natural selection, indigenous breed birds can run fast and fly (to roost in trees) and thus escape from predators, something that commercial breeds (especially broilers) are unable to; as a result of natural selection, indigenous breeds are for the most part more high-temperature tolerant and more resistant to a number of diseases typically encountered in the village environment, than commercial genotypes ; and the meat and eggs from indigenous breed birds are generally preferred to that from commercial broilers and layers, and buyers will often pay a premium for the former, particularly when calculated on a weight basis. It is this latter reality in many countries, including Myanmar, which gave rise to the present investigation of the potential for intensive farming of village chickens in Myanmar.

Since 2003, The University of Queensland (UQ) has made a significant contribution towards improving indigenous chicken production in Myanmar, by identifying and addressing constraints and by exploring opportunities to diversify production. This research was conducted over the past 15 years in three projects funded by the Australian Centre for International Agricultural Research (ACIAR). Previous research in Myanmar focused on increasing survival rates of birds by providing vaccination against Newcastle disease and introducing methods for improved chick rearing.

Over the past few years, the demand by consumers for poultry meat in Myanmar has increased dramatically. Rises in urbanization, incomes and population size are significant factors in this trend. However, the supply of indigenous chickens is often inadequate to meet consumer demand due to reliance on normal village extensive production methods, i.e. natural matings with egg incubation under broody hens, and the very high attrition rate in young chicks (~ 75% to 6 weeks of age). In addition, the performance of birds is limited by the extensive management involving either significant reliance on the birds' ability to forage for food in the environment and/or limited feeding of grain or poultry feed, often with widely varying nutrient composition.

However, diversified and intensive/semi-intensive indigenous chicken production has a great potential because 1) indigenous chicken are sold at premium prices that are often up to four times that of broiler chickens, 2) indigenous chicken are the preferred poultry meat for consumption, 3) indigenous chicken are raised sustainably under free-range conditions without the use of antimicrobials, and 4) indigenous chicken are in high demand because of the increased health consciousness of consumers.

The small-research and development activity reported here focuses on identifying opportunities for small-scale farmers by diversifying rural poultry production. In particular, it explores the opportunities for the development of a semi-intensive indigenous chicken production system that can be adopted by a significant proportion of farmers with limited resources, in particular women, across the whole country. The development of semi-intensive enterprises provides unique business opportunities to female farmers to increase income from sale of eggs and meat, as well as to increase quality nutrient intake of their families, particularly the children.

The small-research and development activity continuous and builds on the research activities in the ACIAR funded project AH/2011/054 (DAHAT PAN). This project researched the health and production of poultry, cattle, goats, and sheep in two villages in Myanmar with the aim of improving household incomes and livelihoods. The DAHAT PAN project focussed to understand the technical constraints and opportunities for small-scale livestock development in the Central Dry Zone (CDZ) and to develop and adapt improved animal production and health practices, which are linked to local and regional market value chains, for small ruminants, indigenous cattle, and indigenous chickens. Although most of the activities focussed on the development of a sustainability methodology to improve the survival of scavenging chickens, it also commenced the development of approaches for semi-intensive indigenous chicken rearing.

In this current project, feasibility studies were used in this research activity to assess the viability of semi-intensive village chicken production, while formative approaches were applied to understand the interests, behaviours and needs of stakeholders for establishing an effective semi-intensive village chicken production value chain. The specific goals of this small research and development activity was to evaluate opportunities for small-scale farmers in Myanmar by diversifying rural poultry production through profitable and sustainable semi-intensive village chicken production. The project objectives were the following:

- Evaluation and refinement of methodology for semi-intensive indigenous chicken production systems for small-scale farmers in Myanmar that commenced under AH/2011/054 (DAHAT PAN)
- Identification of constraints and opportunities for semi-intensive family poultry production in Myanmar

Assessment of profitability and sustainability of semi-intensive indigenous chicken production and evaluation of value chain components for a semi-intensive indigenous chicken production system in Myanmar.

# 4 Evaluation and refinement of methodology for semi-intensive indigenous chicken production systems for small-scale farmers in Myanmar

## 4.1 Aims

The proposed methodology under this objective included a completion of an experimental trial commenced in the DAHAT PAN project to compare different approaches for raising indigenous chickens under semi-intensive conditions, including identification of suitable diets and husbandry practices. However, to address the objective, we conducted a number of on-farm experiments.

### 4.1.1 Field experiments on semi-intensive indigenous chicken rearing

The aims of these field experiments were to 1) develop a methodology to raise indigenous chickens semi-intensively under field conditions, 2) to design and test the infrastructure required (enclosures and sheds) for raising indigenous chickens semi-intensively under field conditions, 3) develop diets for semi-intensive rearing of indigenous chickens and 4) raise indigenous semi-intensively and measure their growth performance.

### 4.1.2 Experiments on intensive indigenous chicken rearing

The aim of these experiments were to compare the effects of commercial and diets varying in protein and energy, upon the growth rate and feed efficiency of indigenous chickens reared intensively.

## 4.2 Field experiments on semi-intensive indigenous chicken rearing

### 4.2.1 Study sites for raising indigenous chickens semi-intensively

Two field experiments were conducted in the two project townships of the former DAHAT PAN project AH/2011/054. The study sites were established in Hpat Yin village in the Myngyian Township and in Yeawai in the Meikthila Township. Conditions for the site selection included 1) sites for raising chickens semi-intensively needed to be located in a sufficiently large area to allow the establishment of enclosures for semi-intensive rearing, 2) sites should be located in an area, where contact with other chickens and visitors is minimized (e.g. at the edge of village), 3) sites needed to be in a location where constant supervision of birds can be maintained by the person managing the flocks (e.g. house of person managing the flocks in close proximity of the enclosures). Two local village chicken farmers with experience in raising indigenous chickens under scavenging conditions and with a strong interest in semi-intensive rearing of indigenous chickens were identified.

### 4.2.2 Facilities for raising indigenous chickens semi-intensively

The facilities for raising indigenous chickens semi-intensively included a pen comprising of 1) an enclosed scavenging area and 2) a raised chicken house within the enclosure.

Four replicates of these pens were erected on each study site. Conditional upon space available in each study sites, the four pens were built in a square or in a row design (Figure 1 & Figure 2). Each pen was designed to accommodate 30 indigenous chickens.

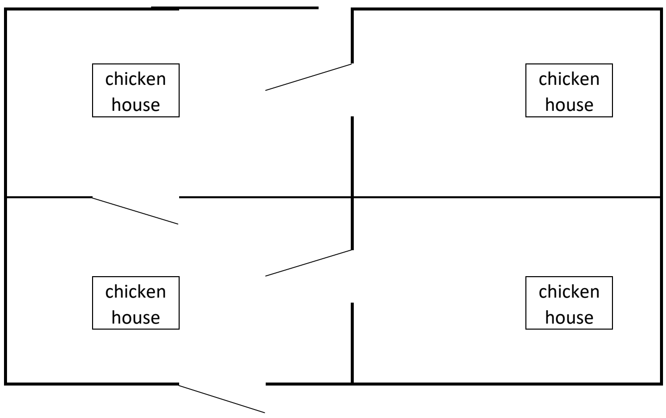


**Figure 1: Design of pens for a trial on raising indigenous chickens semi-intensively in Hpat Yin, Myngyian Township, Myanmar.**

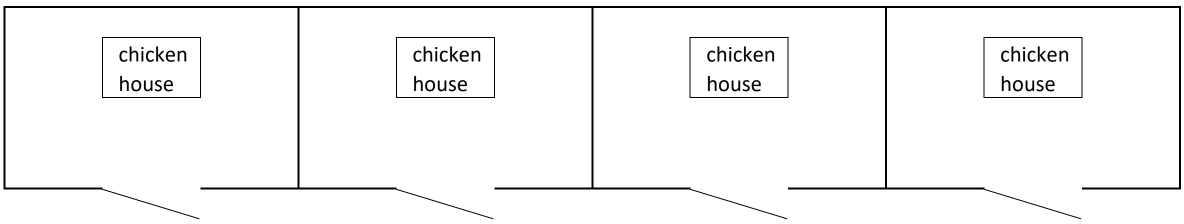


**Figure 2: Design of pens for a trial on raising indigenous chickens semi-intensively in Yeawai, Mekthila Township, Myanmar.**

The enclosure required a strong perimeter fence that needed to be made bird and predator proof. A 180 cm-high internal fence separated the four areas. Gates were installed in the internal and perimeter fences to allow access to all four areas. The gate location and design was determined by the builder. The external gate was designed to provide security, so that no predators could enter the enclosure.

Within each area, a small poultry house was erected to provide shelter, feed and water for the birds. The houses were located near the middle of each of the four pens. The houses were erected above ground and supported on posts and had dimensions of approximately 1.2m wide X 1m deep X 0.8m high (plus a gable roof) (Figure 3). The houses had a raised bamboo slat floor with 5 cm gap between the slats and a floor height of 0.9m above the ground. The front and back sides of the house facing south and north respectively, were suggested to be wire or bamboo mesh to allow ventilation. It was also advised that the sides of the house facing east and west were made of woven palm fronds to shade birds from morning and afternoon sun. The gable roof was covered in palm fronds to keep birds dry and shaded from the sun. It was advised that the gable should extend past the sides by about 0.2m. It was further suggested that the access door should face south. A hanging feeder was placed to one side of the house and a waterer on the other side. The recommended design was slightly modified and adapted to the local conditions in each study site (Figure 4 & Figure 5).

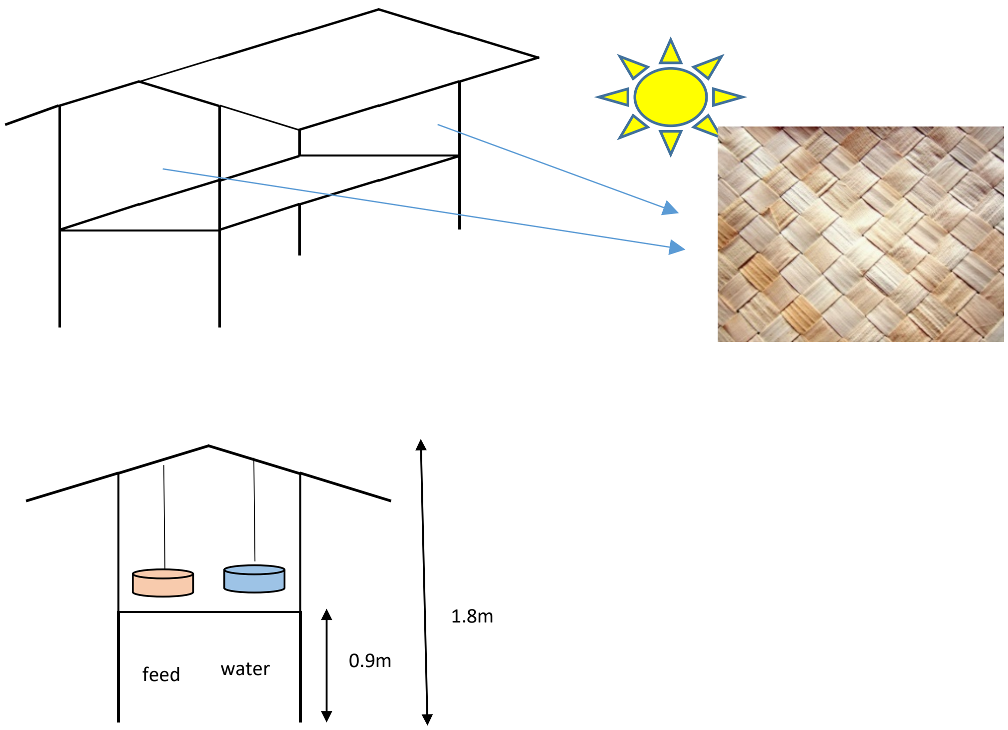


**Figure 3: Schematic design of a poultry house for semi-intensive raising of indigenous chickens. Sides of the house facing east and west should be made of woven palm fronds to shade birds from morning and afternoon sun.**

**Figure 4: Facilities for raising indigenous chickens semi-intensively in Hpat Yin, Myngyian Township, Myanmar.**

**Figure 5: Facilities for raising indigenous chickens semi-intensively in Yeawai, Meikthila, Myanmar.**

### 4.2.3 Sources of birds for semi-intensively field trials

As no breeding farm for indigenous chickens could be identified, indigenous chickens were sourced from local poultry markets or from farmers raising indigenous chickens under scavenging conditions. For each of the two study sites, 120 birds of mixed sex at around 6 weeks of age needed to be sourced. All birds were leg banded.

### 4.2.4 Diets for raising indigenous chickens semi-intensively

Initially it was planned to use two diets with birds in two pens receiving diet I and the birds in the other two pens receiving diet II. However, considering logistic challenges in producing and distributing two different diets to birds, it was then decided to use the relatively low-nutrient -spec diet provided as the starter feed to scavenging chickens in the DAHAT PAN project for the semi-intensive trial. The composition of the diet was developed by the poultry nutritionist, Dr Bob Pym. Using locally available ingredients, the diet was produced in a feed mill owned by Dr Win Naing Phone from the Myanmar Livestock Federation. The composition of the diet, including price changes of ingredients used and the cost of the diet production is shown in Table 1.

**Table 1: Diet formulated for semi-intensive rearing of indigenous chickens, including price changes of ingredients used.**

| **Ingredient** | Percent (%) | Price (July 2017) Kyats/viss | Price (May 2018) Kyats/viss | Price (Sep 2018) Kyats/viss |
|---|---|---|---|---|
| Maize (corn) | 46.06 | 600 | 700 | 650 |
| Rice (broken) | 10.00 | 500 | 500 | 630 |
| Rice bran | 14.26 | 450 | 450 | 530 |
| Soyabean (USA) | 23.50 | 1300 | 1400 | 1450 |
| Sesame seed cake | - | 1050 | 1100 | 1200 |
| Fishmeal | - | 3000 | 3000 | 3100 |
| Limestone (LSP) | 1.35 | 90 | 90 | 100 |
| Salt | 0.52 | 300 | 400 | 400 |
| DCP (viss) | 2.05 | 1200 | 1350 | 1400 |
| Palm oil | - | 2000 | 2500 | 2500 |
| DL methionine (viss) | 0.287 | 8500 | 8500 | 13,000 |
| Choline Chloride (viss) | 1.828 | 2600 | 4500 | 3300 |
| Vit /min premix (viss) | 0.1 | 1170 | 1200 | 1200 |
| Zinc bacitracin (viss) | 0.05 | 8500 | 8500 | 9000 |
| Coccidiostat (viss) | 0.1 | 5900 | 5900 | 6000 |
| **Diet cost** | | **953 Kyats/viss (~ 1000 Kyat per viss), including labour charges and 5% profit** | | **978 Kyats/viss (~ 1000 Kyat per viss), including labour charges and 5% profit** |
| **Metabolizable Energy** | 11.50 MJ/kg | | | |
| **Nutrient name** | | | | |
| Crude protein | 18.09% | | | |
| Dry matter | 88.62% | | | |
| Lysine | 0.90% | | | |
| Methionine | 0.57% | | | |

| | |
|---|---|
| Meth + cysteine | 0.83% |
| Threonine | 0.67% |
| Tryptophan | 0.20% |
| Arginine | 1.20% |
| Isoleucine | 0.77% |
| Leucine | 1.43% |
| Histidine | 0.46% |
| valine | 0.77% |
| Crude fibre | 2.99% |
| Calcium | 0.82% |
| Av phosphorus | 0.50% |
| Sodium | 0.22% |
| chloride | 0.61% |
| Potassium | 0.76% |
| Linoleic acid | 1.87% |

The diet was produced as mash and weighed out in fixed quantities of 1kg into sealed plastic bags. It was estimated that birds would eat approximately 60g per day in the first few months. Considering that birds will be kept for 21 weeks (from about 6 weeks of age) up to1 47 days, the estimated feed consumption was the following:

- 60g per bird are consumed* 120 birds = 7.2kg per day for 120 birds
- 7.2 kg*147 days = 1058.4kg (~1060kg)

Therefore, a total of 1060kg or ~ 650 viss (as 1.63kg=1viss) were required as feed in each study village. The feed was delivered from the feed mill in Myngyian to the township veterinary offices, from where farmers collected the feed by motorbike.

### 4.2.5 Husbandry conditions and monitoring of indigenous chickens raised semi-intensively

Farmers were advised that the 30 birds needed to be allocated to the four pens such that the average weight of the 30 birds allocated to each pen was similar and also that the sex ratio was similar in each allocated group, i.e. the groups were to be as similar as possible at commencement.

Feed was provided ad libitum (i.e. continually) and feeders were filled in in the morning and/or evening, as required. To avoid spillage, it was advised that the feed troughs should not be overfilled, but the birds should have some feed in the troughs at all times. Also water was available at all times. Feed and water were provided in the poultry houses, while birds had constant access to the scavenging area within the pens. Birds were vaccinated against Newcastle disease with the I-2 vaccine in 3-monthly intervals.

Farmers were advised to weigh all birds before they were placed into the pens, at 3-weekly intervals and just before they were sold at market age. As birds were individually led-banded, a bird recording sheet with the respective individual weight measurements needed to be completed at each weighing. In addition, it was advised that feed consumption had to be recorded daily (e.g. number of 1 kg bags provided) in a daily observation form. Furthermore, any health problems of individual birds, mortalities or other events (e.g. escaping birds) needed to be recorded.

### 4.2.6 Results of the semi-intensive trials

The proposed design of the enclosures and chicken houses was excellent and provided adequate protection of birds from predation, while offering scavenging and ad-libitum poultry mesh feeding to all birds. Under the hot conditions of the Central Dry Zone, birds were provided with sufficient shade in and underneath the poultry houses.

However, a number of major challenges were observed. Firstly, it appeared to be very difficult to obtain 120 indigenous chickens at around 6 weeks of age for each of the trials, as birds of such young age are usually not sold at markets or by farmers. For example, the farmer in Meikthila required one month to 'collect' indigenous birds for this trial – he had to visit five villages and estimated ages of birds purchased for the trials ranged between 4 weeks (approximately 0.2 viss) and 8 weeks (approximately 0.4 viss).

Hence it was not possible to obtain information on ages of birds used in these trials and therefore meaningful food intake calculations could not be conducted. Furthermore, farmers did not always weigh all birds in the same regular intervals as some birds lost their leg bands, resulting in inconsistent weight measurements.

The large variation of bird weights (and ages) at the first weighting can be seen for both study sites in Figure 6.

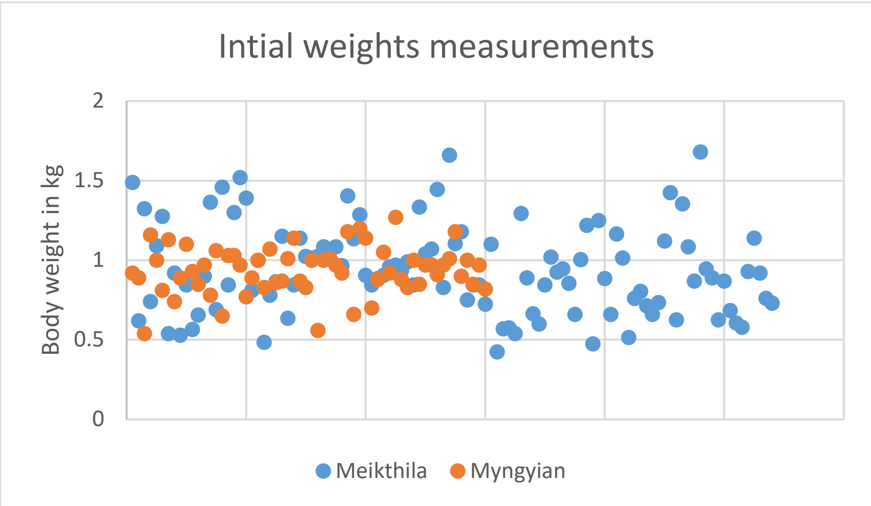


**Figure 6: Initial weight measurement of indigenous birds used in the semi-intensive trials in Meikthila and Myngyian townships, Myanmar.**

Body weight against notional age of the birds in the semi-intensive trial in Mynagyian is shown in Figure 7. The age was estimated for the birds as no information on the exact age existed. In the absence of information on bird ages, it is assumed that mean bird age at commencement of the trial in Myngyian was 70 days.

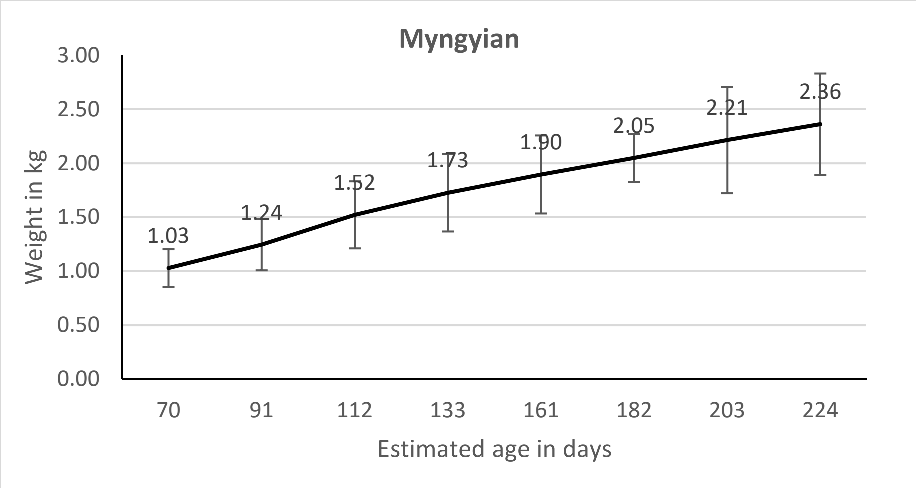


**Figure 7: Mean weight (with standard errors) of indigenous chickens in semi-intensive trial conducted between November 2017 and April 2018 in Myngyian Township, Myanmar.**

Generally speaking the mean weight of birds reached 1.3 kg (or 0.8 viss) in Myngyian quite quickly. There was, as expected, given the unknown age and sex of the birds, a significant degree of variation (mean coefficient of variation of around 20% for Myngyian, with pen variation ranging between 16.5-25.6%) in body weights. As noted, there was, as expected, a diminishing incremental increase in body weight over the measurement period, but overall reasonable growth out to 224 days, with no significant aberrations along the way. The mortality rate in Myngyian was about 4.6%.

In the Meikthila trial, a similar mean weight increase with notional age was observed, although only three weight measurements were conducted. Growth rate between the latter two weight measurements was marginal. There was large variation in the growth rate between pens. Overall, between-bird, within pen variation in growth rate was very high (mean coefficient of variation of around 25.5% for Meikthila, with pen variation ranging between 20.5-27.0%), which is no doubt a reflection of unknown differences in sex and age, but also suggests some impact from environmental influences as well. The mortality rate in the Meikthila trial was about 2.3%.

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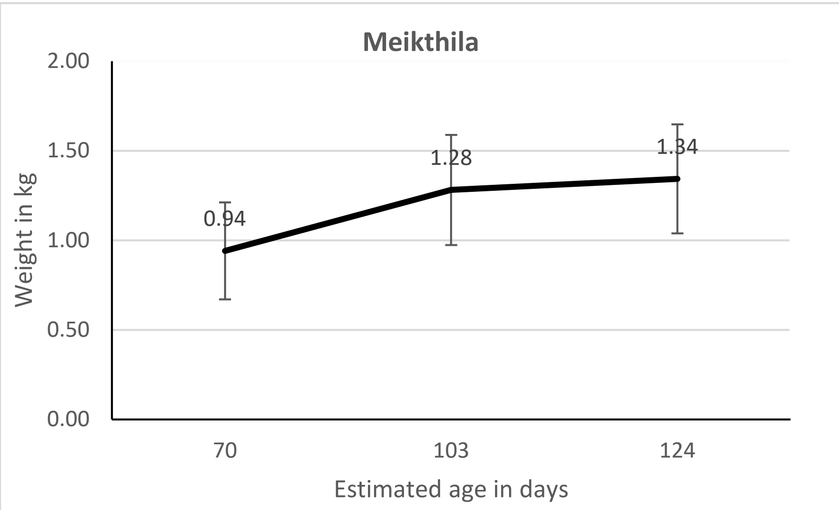


**Figure 8: Mean weight (with standard errors) of indigenous chickens in semi-intensive trial conducted between April 2018 and June 2018 in Meikthila Township, Myanmar.**

### 4.2.7 Discussion and conclusions

Although we were able to develop an appropriate design for semi-intensive rearing facilities, we identified a key challenge for semi-intensive rearing: chicks for semi-intensive (or intensive) rearing were not readily available. This highlights the need to establish breeding farms for indigenous chickens, from where farmers are able to purchase birds for semi-intensive or intensive rearing. For farmers to conduct semi-intensive rearing efficiently, it is very desirable that birds are at the same age at the start of the production period.

Within pen variability quite was high due to the wide range of ages and mixed sexes. It would normally be expected for the within-sex coefficient of variation of younger birds of the same age to be around 10%. The advanced age of the birds in both studies is an important factor in the elevated variation in bodyweight and gains, due in part to the fact that some females would have been approaching sexual maturity, with the associated major physiological changes.

Overall, mortality rates were low, indicating that growing birds were well protected from predation. Whether the birds were challenged with Newcastle Disease (ND) is unknown, so the effect on mortality of vaccinating the birds against ND, is also unknown. However, there is no question about the importance of protecting birds against this disease through an effective vaccination program.

Fighting between the older males in the confined facilities also resulted in stress causing increased variation in growth rate and providing a challenge for the farmers.

The local materials suggested for setting up the enclosures and chickens houses were appropriate and would be affordable for farmers. The cost of construction was about $1000 USD in each study site and facilities should last for at least 5-7 years.

However, raising indigenous chickens under semi-intensive conditions was challenging for farmers, who had only previously worked with the scavenging system. Although detailed instructions were provided and regular visits by supervising LBVD and MLF staff were conducted, farmers found it challenging to conduct daily recording of feed supplied, or to regularly weigh the birds. As leg bands were lost, birds losing bands were not weighed, which reduced the amount of data collected and added to the frustration felt by the farmers and supervisors. This also highlighted the need for further studies of the cost effectiveness of the semi-intensive production system, wherein accurate measures are made of growth and food intake of birds of known age and sex. Once this work is completed, the above experience argues a strong case for the training of farmers in semi-intensive rearing procedures before proposing the uptake of same on a commercial basis.

Given the above experience and the unknown contribution of supplemental scavenging under the semi-intensive system, it was decided to undertake a study of intensive rearing of village chickens of known sex and age, which led to the design of two experiments to be conducted in the Myingyan region. The aim of the studies was to define the effect of dietary nutrient density on growth and feed efficiency of village chickens housed and managed intensively.

## 4.3 Experiments on intensive indigenous chicken rearing

Following the two earlier semi-intensive production trials at Myingyan and Meikthila, two intensive production experiments were conducted in facilities at the poultry farm belonging to Dr Win Naing Phone in Myingyan between September 2018 and February 2019. Both experiments involved assessment of the growth response of village chickens to variation in dietary nutrient density. The justification for this was that the major feed companies in Myanmar produce a range of lower nutrient specification cheaper diets (compared to broiler diets) for use as supplementary feed for semi-scavenging village birds. This posed the question as to how the overall economic performance of these birds, housed under intensive or semi-intensive management conditions, is influenced by dietary nutrient density, and hence, which diets are most appropriate.

### 4.3.1 Aims

The overall aim of the studies was to compare the effects of commercial and diets varying in protein and energy, upon the growth rate and feed efficiency of indigenous chickens reared intensively.

### 4.3.2 Study sites and facility for raising indigenous chickens intensively

The study was conducted in a commercial broiler shed owned by Dr Win Naing Phone in Myngyian (Figure 9).

**Figure 9: Preparations for set-up of experiment 1 to raise indigenous chickens intensively.**

### 4.3.3 Design of intensive rearing experiment 1

#### *Aims of intensive rearing experiment 1*

The aim of experiment 1 was to determine the effects of dietary nutrient density on the growth and feed utilization efficiency of crossbred village chickens from 3 to approximately 18 weeks of age using two different diets. Specific aims were:

1. To identify the age in days when village chickens raised from hatch under intensive conditions reach a market weight of 0.8 viss
2. To measure the effect of dietary nutrient density on the growth and feed efficiency of village chickens raised from hatch under intensive conditions until a market weight of 0.8 viss

#### *Source of birds for intensive rearing experiment 1*

Two-hundred day-old, mixed sex village chicken X Rhode Island Red crossbred chicks were obtained on 30 August 2018 from a hatchery operated by breeder U Nyunt Win, Nat Hmaw village (Pyin Pon Village Tract, Paungde Township, Bago Division) and transported to the poultry farm owned by Dr Win Naing Phone at Myingyan.

At the time, day-old pure-bred village chickens were not available. The breeder provides both types of birds and the reason for producing crossbred chicks is that the RIR hens are considerably better egg producers than village hens, resulting in a more efficient and lower-cost production system. The crossbred chicks perform reasonably similarly to the purebred village birds and are also visually similar.

#### *Diets for intensive rearing experiment 1*

Two diets were used in the experiment, one a commercial broiler grower diet (CP 911) containing 190g Crude protein (CP) and 12.0 MJ ME/kg (Diet 1), and the second, a locally mixed low-spec diet containing 180g CP and 11.5 MJ ME/kg (Diet 2). Both diets were in mash form.

#### *Bird management and allocation to pens for intensive rearing experiment 1*

The day-old chicks were reared from hatch to 21 days of age in a brooding shed with bamboo slatted floors and given the experimental low-spec diet (Diet 2). It was originally intended to commence the diet comparison study at 21 days of age, but there were delays in the construction of the experimental pens, which delayed commencement of the study until 37 days of age (6 October 2018).

At 21 days of age, 100 birds were taken from the group at random and individually weighed. From these weights, four weight groups were identified (quartiles to the nearest 5 gram). All birds were weighed individually and allocated to the appropriate four weight groups. Following this, the same number of birds from each weight group were allocated to each of four crates ensuring similar average weights per crate. Birds were then toe punched according to crate- for later identification for allocation to one of the four experimental pens. The birds were then reared together in the brooding shed up until 37 days of age on the low-spec diet (18.0% CP, 11.5 MJ ME/kg).

At 37 days of age the birds were allocated according to toe punch to the four experimental pens with approximately 50 birds per pen. The Allocation of the diets to the pens is shown in the table below.

| | | | |
|---|---|---|---|
| Pen 1 Diet 1 | Pen 2 Diet 2 | Pen 3 Diet 1 | Pen 4 Diet 2 |

#### *Husbandry conditions and monitoring of intensive rearing experiment 1*

The following instructions, both written and verbal, were given to the operator regarding management of the experiment:

- Diets were to be weighed out into plastic bags with 1.0 kg per bag. Pen and diet numbers to be written on the bags.

- Daily record sheets provided were to be used for recording feed issues and mortalities on a pen basis. An example of the record sheet is shown below.
- Feed was to be provided ad libitum.
- Feed troughs were to be replenished before they became empty, but should NOT be over-filled - to prevent spillage
- Water was to be available at ALL times. Drinkers needed to be kept clean. It was emphasized that a clean, preferably cool, supply of water is important for good bird performance.
- Feed should be allowed to almost run out prior to the bird weighing every three weeks from 6 – approximately 18 weeks of age.
- Weighing of birds should be conducted every 3 weeks, thus birds should be weighed at approximately 6, 9, 12, 15 and 18 weeks It was assumed that the birds would reach market weight of 1.3kg (0.8 viss) at about 18 weeks.
- If the average weight of the birds in the two replicate pens (e.g. birds on diet 1) exceeded 1.3 kg at an earlier age (e.g. 15 weeks), then this group should be terminated at that stage. An example of the bird weight record sheet is shown below.
- Birds were to be vaccinated against Newcastle disease using the I-2 vaccine.

Below are examples of recording sheets used:

<u>Example of feed issue and mortality sheet</u>

| **Event** | **Date** | **Pen No** | **No feed bags provided on that day** | **No birds in pen** | **Comment** |
|---|---|---|---|---|---|
| Feeding | 25/10/18 | 1 | 3 bags | 50 | All birds ok |
| Feeding | 25/10/18 | 2 | 3 bags | 49 | All birds ok |
| Feeding | 25/10/18 | 3 | 3 bags | 48 | All birds ok |
| Feeding | 25/10/18 | 4 | 3 bags | 50 | All birds ok |
| Mortality | 26/10/18 | 1 | | 49 | 1 bird died, heat stress |
| Feeding | 26/10/18 | 1 | 3 bags | 49 | |

<u>Example of bird weight record sheet</u>

| **Date of weighing** | **Pen No** | **N of birds weighed** | **Weight (in kg)** |
|---|---|---|---|
| 12/10/2018 | 1 | 8 | 4.2 |
| 12/10/2018 | 1 | 8 | 4.9 |
| 12/10/2018 | 1 | 8 | 4.6 |
| 12/10/2018 | 1 | 8 | 3.9 |
| 12/10/2018 | 1 | 8 | 4.4 |
| 12/10/2018 | 1 | 9 | 5.0 |
| 12/10/2018 | 2 | 8 | 4.4 |
| 12/10/2018 | 2 | 8 | 4.1 |
| 12/10/2018 | 2 | 9 | 4.9 |

### 4.3.4 Design of intensive rearing experiment 2

#### *Aims of intensive rearing experiment 2*

The aim of experiment 2 was to determine the effects of dietary nutrient density on the growth and food utilization efficiency of purebred sexed village chickens from 3 to approximately 18 weeks of age using two different diets (with replicates)

#### *Source of birds for intensive rearing experiment 2*

200 day-old purebred village chickens were obtained on 18 October 2018 from the hatchery operated by breeder U Nyunt Win, Nat Hmaw village (Pyin Pon Village Tract, Paungde Township, Bago Division). At the hatchery, the day-old chicks were sexed by vent sexing and the males and females then transported in separate boxes to the poultry farm operated by Dr Win Naing Phone in Myingyan

Following arrival at Myingyan the sexed day-old chicks were toe-punched to identify sex (left foot outer web for males, left foot inner web for females). Following this, the chicks were reared together in the brooding shed up until 31 days of age on a commercial broiler starter diet (CP910) containing 210g CP and 12.3MJ ME/ kg.

#### *Diets for intensive rearing experiment 2*

The two diets proposed for use in this experiment were

- Diet 1- a commercial broiler grower diet (CP 911) containing 190g CP and 12.0 MJ ME/kg, and
- Diet 2- a commercial semi-broiler grower diet (CP 915) containing 160g CP and 11.5MJ ME/kg.

Due to perceived problems with availability of the CP 915 diet (Diet 2) the operator made the decision to replace this with commercial diet CP 913 containing 182 g CP and 12.5 MJ ME/kg, making the comparison more about energy: protein ratios than nutrient density.

Due to a delay in the finalization of the preparation of the pens, and to the cool weather at the time, the start date of the experiment was delayed from the originally planned 23 days of age, until the birds were 31 days of age.

#### *Bird management and allocation to pens for intensive rearing experiment 2*

At 31 days, as per suggested pen-allocation table below, birds were toe-punched to identify sex, diet and pen number, as follows:

- All diet 1 birds (pens 1,3,6 and 8) were toe punched on the right foot inner web
- Replicate 1 birds (pens 1,2,3 and 4) were toe-punched on the right foot outer web.

The sexes were then separated into crates using the left foot toe-punch. Following this a group of about 30 birds per sex were weighed individually. From these figures each sex group was divided into four weight groups (quartiles to the nearest 5 gram) (using a total of 8 crates). All birds were then weighed individually and allocated to the appropriate 4 weight groups for each sex. When this was completed the same number of birds from each weight group were allocated to crates prior to allocation to the 8 pens (4 for each sex group). The Allocation of the diets to the pens is shown in the table below.

M = male, F = female

| | | | |
|---|---|---|---|
| Pen 1 Diet 1 F | Pen 2 Diet 2 M | Pen 3 Diet 1 M | Pen 4 Diet 2 F |
| Pen 5 Diet 2 M | Pen 6 Diet 1 F | Pen 7 Diet 2 F | Pen 8 Diet 1 M |

### *Husbandry conditions and monitoring of intensive rearing experiment 2*

The following instructions both written and verbal, were issued to the operator regarding management of the experiment:

The diets were to be weighed out into plastic bags with 1.0 kg per bag. Pen and diet numbers to be written on the bags:

- Daily record sheets provided were to be used for recording feed issue and mortalities on a pen basis. The design of the feed issue, mortality and bird weight record sheets was essentially similar to those used in Experiment 1.
- Feed troughs were to be replenished before they became empty, but to prevent spillage should NOT be over-filled.
- Feed to be allowed to almost run out prior to the bird weighing every three weeks from 6 – approximately 18 weeks of age.
- Weighing of birds to be conducted every 3 weeks, thus birds should be weighed at approximately 6,9,12,15 and 18 weeks (it was assumed that birds would reach market weight of 1.3 kg (0.8 viss) at about 18 weeks)
- Bird weight record sheets to be completed as per sample below
- If the average weight of the birds in the two replicate pens (e.g males on the CP diet, pens 3 and 8) exceeded 1.3 kg at an earlier age (e.g 15 weeks), then this group should be terminated at that stage.





**Figure 10: Intensive rearing trials of indigenous chickens.**

### 4.3.5 Results of intensive rearing experiments

#### *Results of intensive rearing experiment 1*

Growth performance

The data for growth performance from 37 to 93 days of age for the four groups is shown in the table below.

**Table 2: Growth performance in experiment 1 on intensive rearing of indigenous chickens.**

| Pen | Diet* | Bird No | Average weight 37d (g) | Average weight 66d (g) | Average weight 93d (g) | Weight gain 37-93d (g) |
|---|---|---|---|---|---|---|
| 1 | 1 | 47 | 214.8 | 715.2 | 958 | 743 |
| 2 | 2 | 47 | 207.3 | 614.7 | 851 | 644 |
| 3 | 1 | 46 | 210.8 | 732.8 | 1089 | 878 |
| 4 | 2 | 49 | 204.1 | 632.8 | 892 | 688 |

*Diet 1. Commercial broiler diet. 190g CP and 12.0 MJ ME/kg

Diet 2. Experimental low-spec diet. 180g CP and 11.5 MJ ME/kg

There was good agreement between the replicate pens on the two diets to 66 days with some divergence subsequently. Imbalance in sex ratio between the pens may account for some of this variation. Despite this, there was a significant ($P<0.05$) difference in performance between the two diets to 93 days of age with substantially higher growth rates on diet 1.

Based on recorded volumetric feed allocations to the pens, FCR between 37 and 66 days of age was estimated at close to 4.0 on diet 1 and 5.0 on diet 2. These relatively high values compared to broiler figures, are due in part to the late onset of measurement at 37 days of age (at which age broilers are often marketed!), and also to genotype. They do suggest, however, that sale price at market weight for village chickens requires to be quite high to allow reasonable profitability from intensive housing and feeding.

Mortality

Mortality rates in the study were much lower than typically experienced in extensive semi-scavenging conditions. Mortality from receipt of the day-old chicks to toe-punching at 31 days of age was around 5% whereas subsequent mortality was less than 3%, with no indication of an effect of diet.

Constraints

Notwithstanding the explicit nature of the written and verbal instructions provided, and the involvement and close monitoring of measurements by the research assistant at times of bird weighings, the field operator failed to comply with the instruction to provide feed ad libitum, and birds in the four pens were provided with the same restricted daily allowance. This meant that differences in feed efficiency were essentially proportional to growth rate adjusted for differences in bird numbers per pen. The problem did not become evident to the research assistant until the performance data was provided when the birds were 66 days of age, some 29 days after having commenced in the test facility at 37 days of age.

Further, feed issue over this period was measured volumetrically and not by weight, as instructed, so that an accurate measure of feed efficiency was not possible. As all groups were provided with the same amount of feed and bird numbers were essentially similar, the data allows a reasonable estimate of the relative growth performance of the birds on the two diets under what amounted to a mildly restricted feeding regime.

## *Results of intensive rearing experiment 2*

Growth performance

Mean weight of males and females at 31 days of age was 338 and 299 g respectively.

Average weight, average weight gain, average food consumption and FCR per bird from 31 to 85 days of age for pen, diet and sex is shown in Table 3 and for diet and sex averaged across pens is shown in Table 4.

As expected, males grew faster than females, but surprisingly there was no significant difference between the two sexes in food consumption. As such, males were significantly more efficient than females in converting feed into body weight, but due to the effect of the body weight differences on maintenance requirements, it might be expected for males to have an even lower FCR under *ad libitum* feeding.

The higher FCRs over the 31-64d period than over the 64-85 d period are unexpected and indicate that birds were stressed over the earlier period- or that feed consumption measurement over this earlier period was inaccurate and inflated for whatever reason. It would be expected for FCR to be significantly lower (i.e feed efficiency to be higher) over the earlier period. As the diets were quite high nutrient spec diets, the FCRs are generally higher than might be expected.

Overall, growth performance was significantly better on diet 1 (CP911) with 19% protein than on diet 2 (CP913) with 18 % protein, and suggests that protein requirements are still quite high even over the 64-85 days period. The lack of difference in food intake between males and females over all measurement periods, suggests that food was restricted- and/or measured inaccurately. Males would be expected to eat significantly more than females, but to also show higher feed efficiency. Despite the feed restriction, males were significantly more efficient than females. This is somewhat surprising given their higher maintenance requirements associated with their higher average body weights.

There was no consistent effect of diet on FCR and, somewhat concerningly, there was poor replicate agreement for both food consumption and FCR. It is regrettable that the original low-spec CP 915 diet 2 was substituted for by the CP 913 diet, which had slightly lower protein and slightly higher AME than diet 1. It might be expected that there would be relatively little difference in performance between these two diets, as was observed here, but this does not explain the high replicate variation.

Mortality and constraints

During the night following allocation of birds to the pens at 31 days of age on 18/11, out of the total of 200 birds, 21 escaped through holes in the back wall and were lost to predators. Losses per pen of 25 birds ranged from 0 to 6 birds. Repairs were effected and subsequent losses (mortalities) from a variety of causes, were relatively light- approximately 5% to 85 days of age, with no indication of an effect of diet or sex.

**Table 3: Average weight, weight gain, food intake and FCR by pen, sex and diet for intensive rearing of indigenous chickens under intensive conditions (experiment 2).**

| Pen | Sex | Diet | Average weight (g) | | | Average weight gain (g) | | | Average food intake (g) | | | FCR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 31 d | 64 d | 85 d | 31-64 | 64-85 | 31-85 | 31-64 | 64-85 | 31-85 | 31-64 | 64-85 | 31-85 |
| 1 | F | 1 | 292 | 724 | 1064 | 432 | 340 | 772 | 2873 | 1743 | 4616 | 6.65 | 5.13 | 5.98 |
| 2 | M | 2 | 342 | 860 | 1281 | 518 | 421 | 939 | 3139 | 2142 | 5281 | 6.06 | 5.09 | 5.62 |
| 3 | M | 1 | 338 | 918 | 1377 | 580 | 459 | 1039 | 2948 | 2162 | 5110 | 5.08 | 4.71 | 4.92 |
| 4 | F | 2 | 300 | 701 | 1027 | 401 | 326 | 727 | 3248 | 2371 | 5619 | 8.10 | 7.27 | 7.73 |
| 5 | M | 2 | 338 | 884 | 1343 | 546 | 459 | 1005 | 2875 | 2035 | 4910 | 5.27 | 4.43 | 4.89 |
| 6 | F | 1 | 295 | 726 | 1079 | 431 | 353 | 784 | 3646 | 2471 | 6117 | 8.46 | 7.00 | 7.80 |
| 7 | F | 2 | 305 | 727 | 1034 | 422 | 307 | 729 | 3179 | 2011 | 5190 | 7.53 | 6.55 | 7.12 |
| 8 | M | 1 | 335 | 792 | 1331 | 457 | 539 | 996 | 3343 | 2699 | 6042 | 7.32 | 5.01 | 6.07 |

**Table 4: Average weight, weight gain, food intake and FCR by sex and diet for intensive rearing of indigenous chickens under intensive conditions (experiment 2).**

| Sex | Diet | Average weight (g) | | | Average weight gain (g) | | | Average food intake (g) | | | FCR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31 d | 64 d | 85 d | 31-64 | 64-85 | 31-85 | 31-64 | 64-85 | 31-85 | 31-64 | 64-85 | 31-85 |
| M | 1 | 337 | 855 | 1354 | 519 | 499 | 1018 | 3146 | 2431 | 5576 | 6.20 | 4.86 | 5.49 |
| | 2 | 340 | 872 | 1312 | 532 | 440 | 972 | 3007 | 2089 | 5096 | 5.66 | 4.76 | 5.25 |
| F | 1 | 294 | 725 | 1072 | 432 | 347 | 778 | 3260 | 2107 | 5367 | 7.55 | 6.06 | 6.89 |
| | 2 | 303 | 714 | 1031 | 412 | 317 | 728 | 3214 | 2191 | 5405 | 7.82 | 6.91 | 7.42 |

## 4.4 Discussion and conclusions

The intensive rearing experiments allowed us to calculate food utilisation efficiency for indigenous chickens, which is essential for the evaluation of the economic efficacy of intensive and semi-intensive production,

Whilst in experiment 1 an accurate assessment of feed efficiency and economic returns was not possible due to the above constraints on feed issue measurements, the results give a strong indication that village chickens require reasonably high nutrient specification (energy and amino acids) diets to achieve good growth performance. This is supported by the observations (obtained in February 2019) from a commercial producer of village chickens in Myanmar (see section 2.1.3.1. below), that growth performance of his birds has been dramatically improved by switching from a locally produced, relatively low nutrient spec diet, to commercial broiler diets. His birds now achieve a liveweight of 1.3 kg at around 75 days of age compared to 100 days of age previously, and income over feed and chick costs has improved commensurately (see section 2.1.3.1. below). The difficulties encountered in experiment 1, combined with the desirability of obtaining information on the relative growth performance of the two sexes of “purebred” village chickens, prompted the decision to conduct experiment 2 with essentially the same focus of assessing the effect of dietary nutrient density on growth and feed efficiency of indigenous chickens.

In experiment 2 the relatively high FCR measured in all pens over the test period is partly a reflection of the late commencement of measurement, and the extended duration of the test period of 54 days, wherein maintenance requirements for energy and protein become very much more important relative to growth requirements, compared to those over a shorter growing period. Most broiler birds reach the final weights obtained here by 31 days, the starting age for the present birds. The high FCRs obtained in experiment 2 suggest the need to explore ways in which these birds can be grown to market weight more efficiently, either more rapidly to reduce maintenance requirements, or possibly with supplementary foraging under a semi-intensive management system.

Overall, the confined feeding trials demonstrated the potential of semi-intensive and intensive production of indigenous birds to be economically viable, but more work is required to define optimum nutrient composition and marketing age.

# 5 Identification of constraints and opportunities for semi-intensive indigenous chicken production

## 5.1 Aims

The proposed methodology under this objective included:
- Interviews of small-scale indigenous chicken farmers, chicken feed producers and chicken traders and retailers on current practices and opportunities for semi-intensive indigenous chicken production

A number of actors involved in indigenous chicken production were identified and interviewed. This required considerable effort and travel throughout a number of states and divisions of Myanmar.

## 5.2 Breeding of indigenous chickens

### 5.2.1 Breeder of indigenous chickens

A breeder of indigenous chickens, Mr Nyunt Win, was visited in the Nat Hmaw Village, Pyin Pon village tract, Paungde Township, Bago Division. He was the only breeder of indigenous chickens, to be identified after extensive consultations with LBVD and MLF veterinarians across three states and divisions in Myanmar. Mr Nyunt Win kept 50 roosters and 300 hens (120 Rode Island Red and 180 indigenous chickens) and produced 2,000 day-old chicks (DOC) per week (purebred indigenous or indigenous X RIR cross-breed). He is able to produce 800-900 DOC from 1,050 eggs representing an 80% hatchability rate. He uses a Myanmar made incubator with a maximum capacity of 24,600 eggs, which he purchased at a cost of approximately 3,500 USD.

He distributes indigenous chicken DOC to about 100 customers across the whole of Myanmar. The number of DOC he sells varies between 100 and 1,000 (with a maximum of 3,000); he sells DOC directly to customers with no intermediate trader being involved. DOC are sold for 900 Kyat. DOC are sold in boxes that he received free of charge from CP. He disinfects the boxes and places 100 indigenous chickens in one box (normally only 80 CP broiler chicken are placed in one box). DOC are sold unvaccinated. He advertises his business through Facebook and through YouTube videos.

Mr Nyunt Win's breeding farm is comprised of 14 bamboo-constructed sheds (**Error! Reference source not found.**), each 2.1 X 4.2 m in area in which he keeps 1 rooster together with 4-5 hens. He has another large breeding shed with separate breeding pens inside the shed. He started this business 4 years ago and never regretted it – he started with 30 roosters and 100 hens, who he collected from various villages. The breeding of indigenous chickens is now his only income. Of the 350 birds on his farm, about 15-20 birds die every year and he replaces them with birds that he purchases from farmers in the area. He purchases replacements birds at an age of 3 months at a price of 4,000-5,000 Kyat and keeps them under semi-intensive and scavenging conditions until they reach breeding age.

He uses a commercial layer feed from the De Heus feed company to feed his birds. He provides 5 ticals per bird (80 g) per day. Feed prices vary with high prices occurring in August-April (27,500 Kyat per 50kg) and low prices in May-July (25,000 Kyat per 50kg). He considered formulating the feed himself, because feed prices can be high, but only broken rice and rice bran is available in his area. He also provides water cress, banana shoots and other greens to the birds that he plants around the boundary of his farm.

Birds are vaccinated against ND and IBD every 1.5 months via the drinking water (cost is 10,000 Kyat for 1,000 birds for the ND/IBD vaccine). In addition he provides Vitamin E & D in the water to improve egg production (2x per week at a cost of 4,000 Kyat per week). Furthermore electrolytes are provided to chickens.

He and his wife together with a full-time worker manage all activities on the breeding farm. He pays 150,000 Kyat per month to the full-time worker. Mr Nyunt Win indicated that his net income per month is between 1.5-1.8 million Kyat. He keeps no records on feed consumption and sale prices of birds.

Mr Nyunt Win indicated that the main challenges for breeding indigenous chickens are 1) high and fluctuating feed prices, 2) fluctuating egg production and 3) lack of technical know-how on how to increase egg production.


**Figure 11: Indigenous chicken breeding facilities in Paungde Township.**

### 5.2.2 LBVD indigenous chicken breeder farm

The LBVD owned indigenous chicken breeding farm in the Kone Tane Gyi village tract, Nyaunt U Township was visited in September 2018. The LBVD breeding farm comprises of 8 fully-fenced scavenging areas including large poultry houses that are ideal for raising breeding flocks of indigenous chickens under semi-intensive conditions (Figure 12). Only 4 sheds were functional at the time of the visit with a total of 210 birds. Three breeds of indigenous chickens are used - Sittagaung, Imbimwa and Hle Pyiang. The sheds are normally stocked with 1 rooster and 10 hens. One nesting box per 10 hens is provided per shed.

An egg incubator with a capacity of 720 eggs is available on the breeding farm, but it is not really used. Only Newcastle Disease I-2 vaccine is administered to birds on the farm. Two veterinarians and 5 workers are employed on the LBVD breeding farm.

Birds are sold to farmers at an age of one month, but the new manager of the farm (Dr Phoe Sae) was unable to specify the sale price. Normally township veterinary officers inform farmers that birds are available and farmers indicate their interest in purchasing birds. Birds are also often given away to farmers. The manager emphasised that LBVD has a strong interest in indigenous chicken production and has invested significantly in the upgrade of the facilities.

Feed is formulate by LBVD staff and comprises of the following:

- Broken rice: 20% (chicks 20%)
- Corn: 35% (chicks 25%)
- Sesame cake: 17%
- Rice bran: 13%
- Fish meal: 3%
- Oyster shell: 2% (chicks 0.5%)

For chicks, protein content is 21% protein and for adults it is 16-17%. No vitamins or minerals are provided as LBVD staff believe that they have good animal husbandry practices.

**Figure 12: Indigenous chicken breeding farm operated by LBVD**

## 5.3 Raising of indigenous chickens

### 5.3.1 Grower of indigenous chickens

A grower of indigenous chickens was identified in the Paungde Township, Bago Division. Mr Soe Thika operates a combined intensive and semi-intensive production systems using indigenous chickens. He operates one shed of 20-30 metres length in which he normally keeps 500 2-month-old chickens and a large fully fenced outside area in which he had 300 3-month-old grower chickens at the time of the visit (Figure 13). He also kept 180 indigenous layer hens for egg production in a separate shed. Until 3 years ago he produced 3,000 commercial broiler chickens, but since then he has switched to growing only indigenous chickens, as the profit from indigenous chickens is much larger than from broilers. He also indicates that indigenous chickens are more disease tolerant. Only Mr Soe Thika and his wife manage the farm – no worker is employed.

He purchases DOC from Mr Nyunt Win for 900 Kyat. He sells growers at 0.8-0.9 viss at an age of 3.5 months (~100 days) for a price of 5,500 Kyat per viss in September 2018 (and for 6,000 Kyat per viss in February 2019). He also sells fertilized eggs to the village chicken breeder, Mr Nyunt Win at a price of 270 Kyat per egg. Growers are sold to a specific trader, who he phones and who then collects the birds. In addition, he removes faeces every 2 days and sells it, after mixing it with rice straw, to farmers at a price of 500 Kyat for 25 viss bag.

Vaccination against ND/IBD/IB is conducted at 7-8 days of age via eye drop (7,500 Kyat for 1,000 doses), followed by a further IBD vaccination at 14 days through drinking water (8,000 Kyat for 1,000 doses) and a ND/IB vaccination at 21 days through drinking water (7,500 Kyat for 1,000 doses). Additional ND/IB vaccinations are then conducted every month through the drinking water. Estimated mortality is 1-3%, with 10-12 birds lost per 1,000 birds up to 21 days of age and only 6 birds lost out of 1,000 birds between 22 days until market age. If fighting between roosters becomes a problem, he conducts debeaking and provides vegetables to alleviate the fighting.

In September 2018, Mr Soe Thika indicated that he used a locally produced broiler feed for all age groups (Figure 13). He provided 12.5 viss per 500 birds per day to birds in the shed and 25 viss per day to 300 grower birds and 180 laying hens in the enclosure. However, since the end of 2018, he switched to De Heus broiler feed with age-specific feeding and was able to reduce the growing period to 2.5 months to reach the market weight of 0.8 viss. He provided birds up to 21 days with De Heus broiler diet 6010 (37,200 kyat per 50kg bag; 744 Kyat/kg; 2,800 Kcal, CP 21%), between 22-50 days he provided grower diet 6020 (35,300 kyat per 50kg bag; 706 Kyat/kg; 2,900 Kcal, CP 19%) and up to market age he used diet 6030 (33,000 kyat per 50kg bag; 660 Kyat/kg; 2,950 Kcal, CP 17%). He provides feed in feed troughs four times per day ensuring that feed is available at all the times. Water is also constantly supplied.

Based on the management information provided by Mr Soe Thika, feed consumption, feed costs, FCR and total production costs under the two different feeding regimes were calculated (Table 5). Using age-specific feeding and a most likely better quality diet, a reduction in the feed conversion rate from 5.03 using a local produced feed to 3.29 under the De Heus diets and a substantial reduction in the production costs from 4,095 Kyat per bird with the local diet to 3,780 Kyat per bird under the De Heus diets was achieved.

**Table 5: Estimated feed consumption, feed costs, feed conversion rate (FCR) and estimated production costs for raising of indigenous chickens under two different diets under intensive and semi-intensive conditions.**

**LOCAL FEED (BK)**

| Days | Practice | Feed consumption per bird growing period (viss) | Feed cost per bird per growing period (Kyat) |
|---|---|---|---|
| 60 | Intensive | 1.50 | 1260 |
| 90 | semi-intensive | 1.50 | 1260 |
| 105 | semi-intensive | 0.75 | 630 |
| | **Total** | **3.75** | **3150** |

**DE HEUS FEED**

| Days | Practice | Feed consumption per bird growing period (viss) | Feed cost per brid per growing period (Kyat) |
|---|---|---|---|
| 21 | Intensive | 0.31 | 372 |
| 50 | semi-intensive | 0.61 | 706 |
| 75 | semi-intensive | 1.53 | 1765 |
| | **Total** | **2.45** | **2843** |

| | **LOCAL FEED (BK)** | **DE HEUS FEED** |
|---|---|---|
| **FCR** | 5.03 | 3.29 |
| **Costs per bird** | | |
| DOC cost (Kyat) | 900.00 | 900.00 |
| Feeding costs over the production period (Kyat) | 3,150.00 | 2,843.00 |
| Vaccination costs over the production period (Kyat) | 45.00 | 37.50 |
| ***Total cost*** | ***4,095.00*** | ***3,780.50*** |

Due to the shortened growth period from 100 to 75 days using the De Heus diets, his annual returns (@ 6000 kyats/ viss) minus feed, chick and vaccination costs per 1000 birds, have increased from around 2,250,000 kyats with local diet to 4,180,000 kyats using the De Heus diets.


**Figure 13: Facilities and local feed used by a grower of indigenous chickens raised under intensive and semi-intensive conditions.**

### 5.3.2 NGO activities to support indigenous chickens raising under scavenging and semi-intensive conditions

The NGO Terre des Hommes was visited in the Magway Township, Magway Division. The NGO has been operating since 2017 with the objective of promoting semi-intensive raising of indigenous chickens through the supply of birds, funds and feed to farmers (Figure 14). The NGO plans to work with 331 farmers across 25 villages. Farmers are provided with 150,000 Kyat to build an enclosure and a chicken house. One rooster and 9 hens and 45 viss of feed are then provided to the farmers. The feed is formulated and mixed by the NGO using local ingredients. The cost of feed production is 750 Kyat per viss.

The NGO purchases DOC from the village chicken breeder Mr Nyunt Win at a price of 900 Kyat. They are then vaccinated at arrival against ND/IB and kept in an indigenous chicken collection point (approximately 500 birds) until distribution to farmers at an age of 45 days. The NGO expects that farmers will maintain average flock sizes of 30 birds, with 10 birds being used for breeding, 10 birds to be sold or eaten and an expected mortality rate of 33% (the remaining 10 birds).

The NGO also offers training for rural communities in feed formulation, using corn, rice bran, broken rice, dried fish, groundnut cake and sesame cake. The formulation with 18% protein content is promoted for chickens and pigs. In addition, the NGO operates two rice husk hatcheries for indigenous chickens in two villages and conducts hatching experiments to produce chicks for distribution to farmers (but only has a hatchability of 35%).

Overall, the NGO staff is very enthusiastic, but has limited skills to advise farmers on management and disease control of large flocks of indigenous chickens raised under semi-intensive conditions.


**Figure 14: NGO activities to support indigenous chickens raising under scavenging and semi-intensive conditions.**

## 5.4 Feed for indigenous chickens

The production facility of the De Heus feed company located in Myngyian was visited in September 2018 (Figure 15). The production spectrum of the De Heus comprises of 85% complete feeds, 13% concentrates and 2% premixes. It has 57 production facilities across 75 countries. About 49% of the feed produced is for chickens, 24% for pigs, 15% for cattle and 2% for fish. It is operating in Myanmar since 2016, with the 1st production facility built in Yangon, while the 2nd facility opened in Myngyian on the 29/5/2018. The establishment of a production facility in Myangyian resulted in reduced feed transport cost to upper Myanmar. De Heus also operates 3 training centres in Myanmar (Yangon, Mandalay, Myngyian). About 50% of the ingredients for the feed formulation are sourced in Myanmar and the other 50% are imported (in particular soya bean & premix).

De Heus produces 3 types of chicken feed that could considered for intensive and semi-intensive indigenous chicken production: 1) semi-broiler complete feed (Table 6), 2) broiler complete feed (Table 7) and 3) broiler concentrate (Table 8). The semi-broiler complete feed is recommended for indigenous chickens. The broiler complete feed was used by the grower of indigenous chickens Mr Soe Thika. The broiler concentrate need to be mixed by farmers with other ingredients.

**Table 6: Complete semi-broiler feed produced by De Heus feed company In Myanmar.**

| Type | Details | Price |
|---|---|---|
| 6620 | 0-21 days, 19.49-20.6% protein | 674 Kyat/kg |
| 6630P | 22-market age, 17.2% protein | 640 Kyat/kg |
| 6630 | 29-market age, 15.84-16.6% protein | 644Kyat/kg |

**Table 7: Complete broiler feed produced by De Heus feed company In Myanmar.**

| Type | Details | Price |
|---|---|---|
| 6010 | 0-10 days, 21% protein | 787 Kyat/kg |
| 6020 | 11-28 days, 19% protein | 760 Kyat/kg |
| 6030 | Older than 28 days, 17% protein | 711Kyat/kg |

**Table 8: Recommended mix of ingredients with broiler concentrate 8085 produced by De Heus feed company In Myanmar.**

| Composition | 1-14 days | 15-30 days | >30 days |
|---|---|---|---|
| 8085 | 35% | 30% | 28% |
| Corn | 30% | 30% | 30% |
| Broken rice | 25% | 30% | 37% |
| Rice bran | 10% | 10% | 5% |
| **Cost** | 614 Kyat/kg<br>(1001 Kyat/viss) | 579 Kyat/kg<br>(944 Kyat/viss) | 568 Kyat/kg<br>(926 Kyat/viss) |


**Figure 15: Semi-boiler chicken feeds produced by the De Heus feed company in Myanmar.**

## 5.5 Marketing options for indigenous chickens

### 5.5.1 Fried indigenous chickens

Fried indigenous chicken are a popular product with a substantial marketing opportunity. There are specific regions and villages in Myanmar that focus on the sale of fried indigenous chickens. The village Let Pan Pya has many retailers that specialised in this business (Figure 16). Let Pan Pya is located on a main road to Bagan and travellers and buses stop frequently here for meals or snacks. Three types of businesses were identified in this village: 1) about 5 large fried chicken restaurants that sell between 30-65 chickens per day, 2) about 20 small fried chicken restaurants that sell about 15 chickens per day, and 3) approximately 20 street sellers of fried chickens, that sells in average 15 birds per day (but sometimes up to 35 birds) . All fried chicken businesses work with specific middle men (1-3), that provide fresh birds every day. The fried chicken business owners pay between 7,500-8,000 Kyat per viss to the middle men for the live bird and then either 250 Kyat per bird for slaughtering (and the business owner conducts the frying) or 700 Kyat for the slaughtering combined with frying. About 50 people in the village are specialised in slaughtering or slaughtering and frying. The larger restaurants use sunflower oil for frying, where street sellers often use groundnut oil. Fried chickens are then sold cut-up in pieces, with a range of different cuts used by different businesses. Half a fried chicken breast combined with one fried leg are sold between 4000- 6,500 Kyat, depending on the size, while some seller cut up chickens into smaller pieces (prices ranging between 3,500-7,500 Kyat). Fried internal organs are also sold for about 500 Kyat. A single cut-up fried chicken generate between 10,000 and 16,000 Kyat.

Many fried chicken business owners indicated that there is a very high demand for fried village chickens and one street seller indicated that multiple times per year she is unable to purchase enough indigenous chickens to meet the customer's demand. There is a particular high demand for fried village chickens during festivals (water festival, Thadingyut festival in October) and during school holidays (in December). In addition to selling to travellers passing through the village, fried chicken business owners also take orders over the phone. Phone orders range between 20-35 fried birds.

A typical day for a street seller, starts by receiving live birds from the middle men around 7am, slaughtering and frying of birds until 11am and then selling birds until late afternoon. Often all birds are sold out by 2pm and only rarely street sellers have to sell fried birds until the early evening hours (7pm). None of the fried chicken business owners was selling broilers.

Owners of fried chicken businesses welcomed the idea of semi-intensive production of indigenous chickens as they perceive that 1) there will be no shortage of indigenous chickens and 2) purchase prices for indigenous chickens might be reduced. However, one business owner raised concerns about the taste of indigenous chickens, when they are raised semi-intensively and provided with supplementary feed.


**Figure 16: Fried indigenous chicken businesses in Yon Zin Gyi, Myanamr.**

### 5.5.2 Butchers of indigenous chickens

A large scale commercial butcher, U Soe Naing, specialised in slaughtering of indigenous chickens was interviewed in Mandalay (Figure 17). About 3-4 large-scale commercial butchers of indigenous chickens are operating in Mandalay. U Soe Naing also slaughters broilers. He sells 300 viss of slaughtered indigenous chickens and 700 viss of slaughtered broilers per day. He purchases indigenous birds from approximately 15 traders who deliver the birds to his home. He pays in average 7,000 Kyat per viss for live indigenous chickens, most of them weighing between 0.5 -1 viss (he seldom purchases heavier birds) and sells slaughtered birds at 8,500 Kyat per viss. He never buys sick chickens and traders never try to sell sick birds to him. He conducts his business from home and most customers choose the birds that they want to have slaughtered and wait until birds are slaughtered (it takes about 5 minutes). Most customers purchase 3-4 birds and intestines are also given to the customers. Feathers of birds are collected by the municipality. He also slaughters indigenous birds for retail outlets or individual retailers, who sell them at the markets (retailers purchase up to 40 birds). About 50% of his customers are individual customers and 50% are retailers, but he gives priority to individual customers over the retailers.

He has no fridges or freezers to keep slaughtered birds. If he can’t sell all the birds he purchased on within a day, he will keep them alive until the following day. He employs 12 staff per day for slaughtering and pays them 150,000 Kyat per month per person.

The only constraint he faces is the shortage of indigenous chickens in summer (March/April), when he often can’t meet customer’s demand. He thinks that semi-intensive village chicken raising provides a great opportunity, because 1) there will be no shortage of indigenous chickens, 2) farmers will provided with opportunities to increase their income, and 3) he can increase his income as more birds can be slaughtered and sold.

**Figure 17: Large scale butcher of indigenous chickens in Mandalay, Myanmar.**

### 5.5.3 Trading for indigenous chickens

A number of traders and middle men were interviewed across various townships (Figure 18). A large scale trader, U Nuts Lay, operating from Meikthila indicated that he purchases 500-1000 birds from 14-15 middle me per day. He purchases indigenous birds from three village markets to which middle men deliver their birds. He pays in average 7,000 Kyat per viss and sells birds for 8,000-8,500 Kyat per viss. If he can't purchase enough indigenous chickens from middle men at the village markets, he has to travel to other regions fand townships urther away. Every 5 days he send 1,000 birds to Lashio. There is a large Chinese community in Lashio, which like to consume birds of the 'Chinese native chicken breeds' with black skin. As insufficient numbers of 'Chinese native chickens' are available in Lashio, Myanmar indigenous chickens are also very popular. He sells birds to other traders in Lashio, who slaughter them and sell slaughtered birds, including internal organs for 10,000 Kyat. He hires a truck for a price of 200,000 Kyat to deliver the birds to Lashio. He would welcome a semi-intensive indigenous chicken system, because 1) there will be more village chickens available, 2) there is no need to pay middle men as he purchase birds directly semi-intensive indigenous chicken producers and 3) there are less transport costs as he does not have to travel so far.

Interviews with middle men highlighted their difficulties in finding a sufficient number of indigenous chickens. They purchase between 40 – 70 birds per day and usually travel by motorbike to villages. Some middle men 'employ' informants who identify farmers that are willing to sell birds (these informants receive a small commission). Middle men have to travel further, if there is a shortage of indigenous chickens, often requiring to travel to 6-8 villages (sometimes working between 7am to 5pm to find a sufficient number of birds). Middle men indicated that farmers living in isolated areas have often larger flock sizes of indigenous chicken compared to farmers in easier accessible villages. Middle men highlighted that they never purchase sick birds or indigenous birds that weigh more than 1-1.5 viss. All middle men welcomed the idea of semi-intensive rearing, because 1) larger flocks of indigenous chickens can be maintained by farmers compared to scavenging flocks and therefore it will be easier to 'find' birds and 2) weight loss of birds during transport will be reduced as middle men don't have to travel so far and travel time will be reduced.

**Figure 18: Traders and middle men working with indigenous chickens.**

## 5.6 Discussion and conclusions

We were able to identify some entrepreneurs, who produce already DOC of indigenous breeds/ecotypes or conduct growing of indigenous chickens under intensive/semi-intensive conditions. Although examples of such producers are rare, it highlights that intensive/semi-intensive indigenous chicken production is an acceptable and viable production system for farmers, although the need for support and research-based advice was also iterated by these entrepreneurs. Encouraging is also the interest and effort of an NGO to promote semi-intensive rearing, but their lack of expertise in poultry feeding, husbandry and breeding need to be addressed. Furthermore the strong interest by LBVD to invest into indigenous chicken production is encouraging and the breeding farm visited has a great potential as a hub for the distribution of chicks for semi-intensive rearing, but also as a training facility for farmers being interested in this production system. In additions, some excellent well-compounded diets for intensive/semi-intensive indigenous chicken are already produced and available in Myanmar. They have been used by the interviewed grower of indigenous chickens and have produce better FCRs, shorter production cycles and thereby better returns compared to local chicken diets.

A constraint highlighted by middle men, traders, butchers and retailers of indigenous chickens ('fried village chicken businesses') was the shortage of indigenous chickens at certain times of the years. All of the business owners welcomed the idea of semi-intensive indigenous chicken rearing. However, some concerns were raised by retailers in regards to the taste of indigenous chickens produced under supplementary feeding and this customer preference needs to be further researched.

# 6 Assessment of profitability and sustainability of semi-intensive indigenous chicken production and evaluation of value chain components for a semi-intensive indigenous chicken production system in Myanmar

## 6.1 Aims

The proposed methodology under this objective included:

- Evaluation and economic modelling of inputs, outputs and outcomes for raising indigenous chickens under semi-intensive conditions
- Assessment of value chain components for semi-intensive indigenous chicken production in Myanmar, in particular breeding, management, and marketing of chickens raised under semi-intensive conditions.

Under this objective we conducted a 1) cost-benefit analysis of raising indigenous chickens semi-intensively compared to scavenging conditions and 2) a value chain analysis of the raising and marketing of indigenous chickens produced semi-intensively.

## 6.2 Cost benefit analysis

We conducted a cost benefit analysis focussing on the comparison of three production systems using indigenous chickens and on commercial broiler production as a comparison:

1. Semi-intensive and intensive rearing
2. Scavenging rearing with improved chick management
3. Scavenging rearing under traditional conditions
4. Commercial broiler production

Scavenging rearing with improved chick management was developed in ACIAR project AH/2002/042 and further modified in ACIAR project AH/2011/054. The aim of improved chick management is to reduce the attrition rate of young chicks in the first 6 weeks after hatching. This is achieved by protecting chicks from predation and exposure to climatic stress by using coops and creep feeders under a specially designed management program. Age-appropriate feeding (equivalent to a chick-starter diet) is provided to chicks to provide them with the nutrients they require and to avoid malnutrition, particularly during the early growing period, while some supplementary feed is provided to the hen and older chicks. The specific chick management procedures adopted to reduce the attrition rate of young chicks to about 6 weeks of age and by protection of chicks from predation and exposure to climatic stress include the following:

From birth up to 1 week:

- Confinement rearing with the hen for 1 week under the bamboo coops (day and night) with no access to the yard. Chicks are kept inside the creep feeder under the bamboo coops during this period.
- Chick starter diet is supplied for every hatch of chicks. The feed has to be placed ideally into the dish within the creep feeder.
- The hen should be provided with about 50 g cracked rice per day during this period of confinement.

From 2 to 3 weeks:

- Daytime access with the hen to the surrounding environment but confinement at night with the hen under the bamboo coops.
- During the night time, the chicks are provided initially with any residual chick starter, and following this with broken rice. The creep feeders could be used during the day outside the

coop to ensure that the young birds get adequate supplemental feed (residual chick starter, and following this with broken rice) and also provide a refuge from predation.

From 3 to 6 weeks:

- Daytime access with the hen to the surrounding environment, but confinement at night by themselves.
- During the daytime supplemental feeding using cracked rice.

### 6.2.1 Input parameters and model development for cost-benefit analysis

To conduct the cost-benefit analysis we used data generated through interviews with village chicken breeders and growers, data generated from the trials on intensive and semi-intensive village chicken raising and information collected in intervention and cross-sectional studies on improved chick rearing and traditional rearing of indigenous chickens under scavenging conditions ( collected under previous ACIAR research projects in Myanmar). Data on input parameters for the commercial broiler production were obtained through discussions with small-scale commercial broiler producers in Myanmar.

The following input parameters were used for indigenous chicken production (Table 9):

**Table 9: Input parameters for cost-benefit analysis to compare semi-intensive and intensive rearing, scavenging rearing with improved chick management and scavenging rearing under traditional conditions using indigenous chickens.**

| **All rearing systems for indigenous chickens** | | Unit |
|---|---|---|
| Weight at market age | 0.8 (1.3) | Viss (kg) |
| | | |
| **Intensive and semi-intensive rearing** | | |
| Clean-out period between batches | 14 | Days |
| DOC cost | 900 | Kyat/chick |
| | | |
| **Scavenging rearing** | | |
| Flock size | 30 | |
| Batches per hen per year | 3 | |
| Productive hens | 4 | |
| Batches  per year | 12 | |
| Eggs laid per batch | 12 | |
| Chicks hatched | 10 | |
| Hatchability | 80% | |
| | | |
| Mortality 6 - 20 weeks | 10% | |
| Mortality 20-50 weeks | 15% | |
| | | |
| Marketing age at 0.8 viss | 20 | Weeks |
| | | |
| Replacement hens kept within a flock | 3 | |
| | | |
| Amount of broken rice feed to growers and adults | 1 | cup per day per flock (1cup=180g) |
| Price of broken rice | 300 | Kyat/kg |
| Broken rice feed cost per year (54 Kyat/day*365 days) | 20,000 | Kyat |
| | | |
| Vaccination cost (ND) (30 birds * 10 Kyat/dose * 3 times per year) | 900 | Kyat |
| | | |
| **Scavenging rearing - traditional system** | | |
| Mortality 1 -6 weeks | 50% | |
| | | |
| **Scavenging rearing - improved chick rearing system** | | |
| Mortality 1 -6 weeks | 20% | |
| Cost of coop (lasts 3 years) | 6000 | Kyat |
| Cost of creep feeder (lasts 3 years) | 6000 | Kyat |
| Starter feed cost per batch/hatch | 700 | Kyat |

For simplicity, no paid labour costs were considered as scavenging systems require minimal inputs, which are usually conducted by family members (and in the small-scale, intensive and semi-intensive rearing of indigenous chicken conducted by Mr Soe Thika also no paid labour was used). Vaccination cost for intensive and semi-intensive rearing were also not considered (and these costs are low). The construction cost for building a chicken house and enclosure for intensive and semi-intensive rearing (estimated to be between 1000USD-1500USD in the semi-intensive trial conducted in Meikthila and Myngyian) were also not included.

The following input parameters were used for commercial broiler production (Table 10):

**Table 10: Input parameters for cost-benefit analysis of commercial broiler production in Myanmar.**

| | | |
|---|---|---|

## 6.2.2 Results of the cost-benefit analysis

### *Intensive/semi-intensive raising of indigenous chickens*

The estimated ME intake, feed intake, FCR and feed cost per bird at different market ages for intensive/semi-intensive raising of indigenous chickens is shown in Table 10. The FCR ranged from 3.19 at a market weight of 70 days to 6.32 at a market weight of 133 days. The feed costs associated with these FCR were then used to estimate the returns per bird at different sale prices (as reported by farmers and traders over the past year) (Table 11). A return of about 500 Kyat per bird was still possible to achieve with an age age of 105 days for sales prices of 6500 Kyat per viss, at market age of 91 days for sales prices of 6000 Kyat per viss, but only at a market age of 70 days for sales prices of 5500 Kyat per viss.

We then estimated sale return (Kyat) per year at different market ages and flock sizes (at a sale price of 6000 Kyat/viss) for intensive/semi-intensive raising (Table 12). The numbers demonstrate the quantum of returns from various flock sizes, i.e .500 birds reaching market weight of 0.8 viss (or 1.3 kg) at 70 days would return over 2,000,000 Kyats (minus vaccination and other costs), but for those taking 98 days to reach 0.8 viss, returns from the same flock size was down to around 500,000 kyats. As seen in Figure 19 substantial returns can be achieved at flock sizes of 300-500 birds for a market age up to 91 days. However, raising birds over 112 days would not produce any positive returns.

Finally we estimated sale return (Kyat) per year at different market ages and varying mortality rates (sale price of 6000 Kyat/viss, flock size of 500 birds) for intensive/semi-intensive raising of indigenous chickens (Table 13). To evaluate the effect of mortality, we looked at a low mortality of 5% either spread evenly over the growth period, or occurring during the last week before slaughter - we did the same for a much higher mortality rate of 20%. The reason for the difference is that late mortality impacts far more on profit than early mortality due to the fact that the dead birds had eaten a lot of feed. Again the calculation was based on 500 birds at 6000 kyats per viss. Mortality in the first week has, of course, very little impact on food costs, and DOC costs are unaffected by any of this.

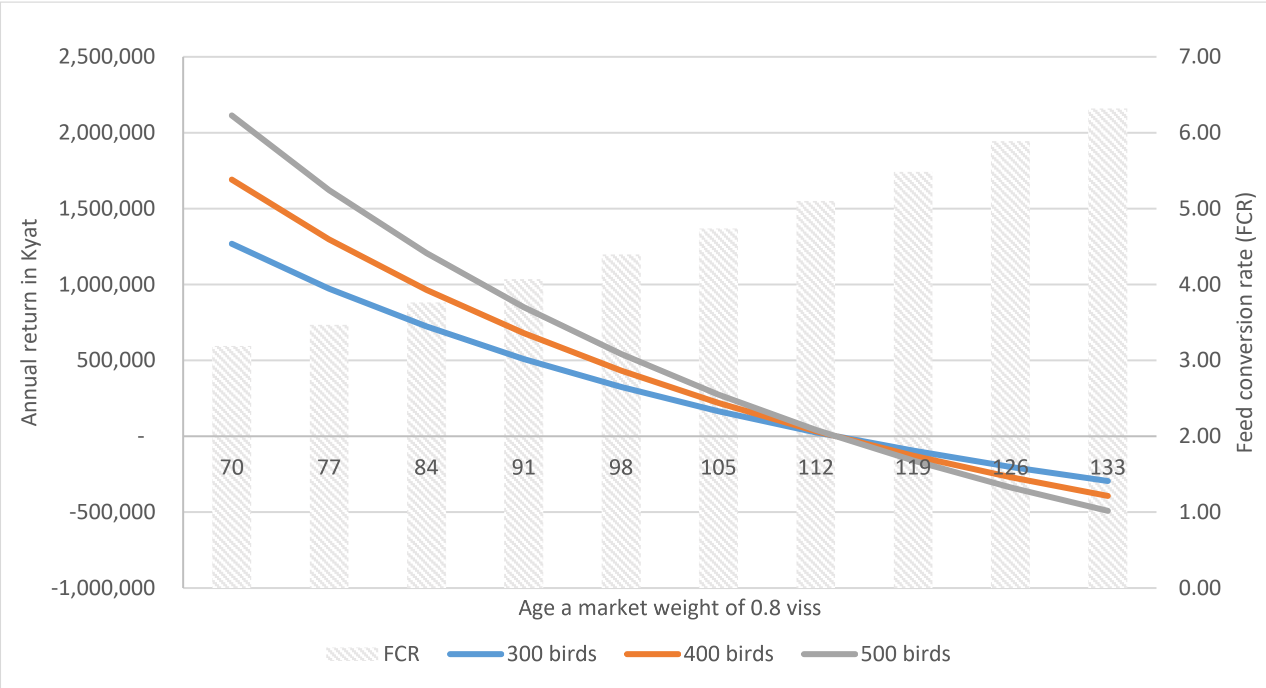


**Figure 19: Annual return from raising indigenous chickens under intensive/semi-intensive conditions at different marking ages and by flock size. The feed conversion rate for each marketing age is also displayed.**

**Table 11: Estimated ME intake, feed intake, FCR and feed cost per bird at different market ages for intensive/semi-intensive raising of indigenous chickens.**

| Age (days) at market weight of 0.8 viss | 70 | 77 | 84 | 91 | 98 | 105 | 112 | 119 | 126 | 133 |
|---|---|---|---|---|---|---|---|---|---|---|
| Estimated growth requirement @20,000KJ | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 |
| Maintenance ME requirement @455KJ/d | 31850 | 35035 | 38220 | 41405 | 44590 | 47775 | 50960 | 54145 | 57330 | 60515 |
| ***Total ME intake (KJ)*** | ***51850*** | ***55035*** | ***58220*** | ***61405*** | ***64590*** | ***67775*** | ***70960*** | ***74145*** | ***77330*** | ***80515*** |
| Mean Diet ME (MJ/kg) | 12.5 | 12.2 | 11.9 | 11.6 | 11.3 | 11 | 10.7 | 10.4 | 10.1 | 9.8 |
| Feed intake (g) | 4148 | 4511 | 4892 | 5294 | 5716 | 6161 | 6632 | 7129 | 7656 | 8216 |
| ***FCR*** | ***3.19*** | ***3.47*** | ***3.76*** | ***4.07*** | ***4.40*** | ***4.74*** | ***5.10*** | ***5.48*** | ***5.89*** | ***6.32*** |
| Feed price (Kyats/g) | 0.70 | 0.68 | 0.66 | 0.64 | 0.62 | 0.60 | 0.58 | 0.56 | 0.54 | 0.52 |
| ***Feed cost (Kyats/bird)*** | ***2903.60*** | ***3067.52*** | ***3229.01*** | ***3387.86*** | ***3543.88*** | ***3696.82*** | ***3846.43*** | ***3992.42*** | ***4134.48*** | ***4272.22*** |

ME - Metabolizable Energy

Feed intake = Mean Diet ME/total ME intake

Maintenance ME requirements based on 700 kJ/ kg W/ day (Pym (2005), at an average body weight of 0.65 kg, maintenance requirement = 455 kJ ME/ day

**Table 12: Estimated sale return (Kyat) per bird at different market ages and sale prices for intensive/semi-intensive raising of indigenous chickens.**

| Age (days) at market weight of 0.8 viss | 70 | 77 | 84 | 91 | 98 | 105 | 112 | 119 | 126 | 133 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sale price** | | | | | | | | | | |
| 6500 Kyat/viss | 1371 | 1207 | 1046 | 887 | 731 | 578 | 428 | 282 | 140 | 2 |
| 6000 Kyat/viss | 973 | 809 | 647 | 489 | 333 | 180 | 30 | -116 | -258 | -396 |
| 5500 Kyat/viss | 575 | 411 | 249 | 91 | -65 | -218 | -368 | -514 | -656 | -794 |
| 5000 Kyat/viss | 177 | 13 | -149 | -307 | -463 | -616 | -766 | -912 | -1054 | -1192 |

Return = (0.8viss * sale price) - Feed cost (Kyats/bird) - DOC cost (Kyat/chick)

**Table 13: Estimated sale return (Kyat) per year at different market ages and flock sizes (sale price of 6000 Kyat/viss) for intensive/semi-intensive raising of indigenous chickens.**

| **Age (days) at market weight of 0.8 viss** | **70** | **77** | **84** | **91** | **98** | **105** | **112** | **119** | **126** | **133** |
|---|---|---|---|---|---|---|---|---|---|---|
| Batches per year | 4.35 | 4.01 | 3.72 | 3.48 | 3.26 | 3.07 | 2.90 | 2.74 | 2.61 | 2.48 |
| **Flock size** | | | | | | | | | | |
| 300 birds | 1,268,225 | 973,419 | 723,456 | 509,564 | 325,185 | 165,324 | 26,119 | - 95,453 | -201,785 | -294,786 |
| 400 birds | 1,690,967 | 1,297,893 | 964,608 | 679,419 | 433,579 | 220,432 | 34,826 | -127,270 | -269,047 | -393,047 |
| 500 birds | 2,113,708 | 1,622,366 | 1,205,760 | 849,273 | 541,974 | 275,539 | 43,532 | -159,088 | -336,309 | -491,309 |

Batches per year = 365 days/(age at market weight + 14 days clean out period)

**Table 14: Estimated sale return (Kyat) per year at different market ages and varying mortality rates (sale price of 6000 Kyat/viss, flock size of 500 birds) for intensive/semi-intensive raising of indigenous chickens.**

| **Age (days) at market weight of 0.8 viss** | **70** | **77** | **84** | **91** | **98** | **105** | **112** | **119** | **126** | **133** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mortality rate** | | | | | | | | | | |
| 5% evenly spread | 2,030,003 | 1,540,710 | 1,126,123 | 771,621 | 466,273 | 201,750 | - 28,387 | -229,183 | -404,628 | -557,906 |
| 5% in last week | 1,993,708 | 1,502,366 | 1,085,760 | 729,273 | 421,974 | 155,539 | - 76,468 | -279,088 | -456,309 | -611,309 |
| 20% evenly spread | 1,778,908 | 1,287,566 | 870,960 | 514,473 | 207,174 | - 59,261 | - 291,268 | -493,888 | -671,109 | -826,109 |
| 20% in last week | 1,633,708 | 1,142,366 | 725,760 | 369,273 | 61,974 | -204,461 | - 436,468 | -639,088 | -816,309 | -971,309 |

The effect of mortality was calculated as follows: for 20% mortality occurring in the last week- there is no adjustment to food intake/cost on the assumption that there is essentially no food savings, but returns are reduced by 20%. With 500 birds at 70-d slaughter, the calculation is (2113708-100 X 4800) = 1633708.

For 70-d slaughter with 20% mortality evenly spread, the calculation is (2113708- 100 X 4800 + 50 X 2904) = 1778908

Where: “100” is the number of birds which died (20% of 500), 4800 (kyats) is the price per 1.3 kg bird @ 6000 kyats/viss), 2904 is the food cost (kyats/bird) and the “50” in the even spread mortality calculations represents the mean number (100/2) of birds which ate the full amount of food over the 70 d period, It’s a linear adjustment for the birds which died early and ate relatively little feed

### *Scavenging rearing of indigenous chickens*

The annual returns from scavenging indigenous chickens under an improved system involving confinement with the hen to 6 weeks and creep feeding, and under a traditional scavenging system are shown respectively in Table 14 and Table 15.

The figures suggest very considerable benefit to scavenging rearing with confinement with the hen and supplemental creep feed with 197,000 kyats per year versus 66,000 kyats per year under the traditional system, i.e. returns over variable costs are three times higher with the former system.

**Table 15: Scavenging rearing - improved chick rearing system.**

| **Scavenging rearing – confinement with hen and creep feed** | |
|---|---|
| **Annual returns** | |
| N birds per batch alive at 6 weeks | 8 |
| N birds per batch alive at 20 weeks | 7 |
| N birds sold per batch | 4 |
| N birds sold per year (12 batches * 4 birds) | 48 |
| *Return from sales (N birds sold per year * 4800 Kyat/bird) (Kyat per year)^* | *230,400 Kyat per year* |
| **Annual costs** | |
| Annual cost for coop (6000 kyat/3 years) | 2,000 Kyat per year |
| Annual cost for creep feeder (6000 kyat/3 years) | 2,000 Kyat per year |
| Annual cost for starter feed (12 batches * 700 Kyat) | 8,400 Kyat per year |
| Vaccination costs | 900 Kyat per year |
| Broken rice feed cost per year (Kyat) | 20,000 Kyat per year |
| *Total costs (Kyat)* | *33,300 Kyat per year* |
| **Total return per year (Kyat)** | **197,100 Kyat per year** |

^ represents 0.8 viss marketing age * 6000 Kyat/viss

**Table 16: Scavenging rearing - traditional system**

| **Scavenging rearing - traditional system- no confinement and creep feed** | |
|---|---|
| ***Annual returns*** | |
| N birds per batch alive at 6 weeks | 5 |
| N birds per batch alive at 20 weeks | 4.5 |
| N birds sold per batch | 1.5 |
| N birds sold per year (12 batches * 1.5 birds) | 18 |
| *Return from sales (N birds sold per year * 4800 Kyat/bird)^* | *86,400 Kyat per year* |
| ***Annual costs*** | |
| Broken rice feed cost per year | 20,000 Kyat per year |
| *Total costs* | *20,000 Kyat per year* |
| ***Total returns per year*** | **66,400 Kyat per year** |

^ represents 0.8 viss marketing age * 6000 Kyat/viss

## *Commercial broiler production*

To compare returns from intensive/semi-intensive village chicken production to other commercial poultry production approaches, annual returns from broiler production in Myanmar were calculated. Assuming that broilers are sold at an age of 35-40 days weighing approximately 1 viss (or 1.63 kg), an average broiler flock size of 500 birds, a lower FCR of approximately 1.8 compared to indigenous chickens and feed and DOC broiler costs under Myanmar conditions, the annual return was calculated for two different sale prices: 2,000 and 2,500 Kyat per viss (Table 17). A change in the sale price by only 500 Kyats resulted in an almost tripling of the annual returns from broiler production.

**Table 17: Estimated returns from commercial broiler production in Myanmar.**

| Sale price per viss live weight (Kyat) | 2,000 | 2,500 |
|---|---|---|
| | | |
| Bird live weight at sale (viss) | 1.0 | 1.0 |
| Flock size | 500 | 500 |
| Batches per year | 6 | 6 |
| | | |
| FCR | 1.8 | 1.8 |
| Food cost Kyats/viss | 460.0 | 460.0 |
| DOC cost Kyats/ chick | 900.0 | 900.0 |
| Food consumption/ bird | 1.8 | 1.8 |
| Food cost Kyat/ bird | 828.0 | 828.0 |
| Food + DOC cost Kyat/ bird | 1,728.0 | 1,728.0 |
| | | |
| Sale price per bird (Kyat) | 2,000 | 2,500 |
| Sale return minus food and chick costs/ bird (Kyat) | 272 | 772 |
| Sale return minus food and chick costs/ batch (Kyat) | 136,000 | 386,000 |
| **Total return per year (Kyat)** | **816,000** | **2,316,000** |

### 6.2.3 Discussion of the cost-benefit analysis

Under the intensive/ semi-intensive system calculations, maintenance energy requirements increased linearly with age required to reach the normal market liveweight of 0.8 viss. (Table 7). This caused food intake and FCR to increase commensurately, which resulted in a substantial increase in food cost. This happened despite a reduction in the price of the lower nutrient spec diet calculated to achieve this growth response. The slower growth rates could also be achieved with restricted feeding of a higher nutrient spec diet accompanying foraging associated with a semi-intensive production system, wherein overall food costs to marketing age were essentially similar to those for intensive production employing a lower spec diet.

The impact of variation in sale prices for indigenous birds at 0.8 viss from 5000 to 6500 kyats per viss shown in table 8, demonstrates that income minus feed and day-old chick costs at the higher returns, decreases but is still positive at a growth period of 133 days, but is negative at growth periods in excess of about 80 days at a return of only 5000 Kyat/viss. It is thus essential where sale prices are low for birds to be given high nutrient spec diets and to grow rapidly to achieve profitable results. As shown above, at a sale price of 6000 Kyat/viss, income over feed and chick costs become negative at growth periods greater than 112 days, and are substantial and positive at growth periods shorter than 80 days.

The quantum of returns over variable costs for different flock sizes demonstrates that even with a flock size of only 500 birds, the annual returns are in excess of 2 million kyats for a growth period of 70 days and a sale price of 6000 Kyat per viss. Returns are dramatically reduced with growth periods greater than 100 days. The effect of mortality on returns demonstrates the impact of high mortality on returns, particularly if the mortality occurs late in the growing period, where the dead birds have eaten a considerable amount of feed. Early mortality has little impact on feed costs, but profitability is reduced due to the day-old chick costs of the dead birds.

Although broilers fetch considerably lower sale prices than indigenous chickens, the better feed conversion rate and the faster growth rate of birds until they reach a sale weight compared to indigenous chickens, provides a reasonable business opportunity for poultry farmers. Unfortunately, sale prices for broilers can fluctuate substantially (while sale prices for indigenous chickens would appear to be reasonable stable), highlighting potential uncertainties associated with broiler production.

Overall, this study has demonstrated the importance of achieving good growth performance from the birds in order to achieve good profitability from intensive or semi-intensive production with village chickens. It is acknowledged that optimal economic performance from these birds, as a consequence of their considerably lower genetic potential for growth, than broilers, may be achieved on diets with lower nutrient specifications than commercial broiler diets. However, considerably more work is required to define the nutrient requirements of these birds and hence to develop optimal diets to maximise economic performance.

The impact on profitability of scavenging village chicken production employing ND vaccination, confinement rearing of chicks with the hen and creep feeding, in comparison with traditional rearing practice, is clearly demonstrated in the results. Income over feed and other variable costs was three times greater under the former system. The critical elements of the difference relate to the greatly reduced chick attrition rate, resulting in considerably more birds being available for sale

In comparing returns from the typical household scavenging flock (incorporating improved rearing) with intensive production involving a flock of 500 birds, overall annual returns from the latter are very much greater. However, costs listed herein do not include housing costs, and these would be significantly greater under intensive production, reducing overall profitability. The former household scavenging approach to poultry production would undoubtedly have more appeal to risk averse farmers, but there is undoubted scope for profitable intensive production of village chickens by farmers with ability and entrepreneurial skills.

## 6.3 Value chain analysis

### 6.3.1 Overview of the value chain analysis approach

Value chain approaches are part of a group of methods that describes the flows of resources, materials and information within a chain of activities that go towards the production of particular product, from the start of the production to the sale to the final customers. It focusses on the linkages between different actors, how their activities are coordinated and the needs of the final users. The analysis tries to discover 1) why the chain performs in that way, 2) how it can be made more efficient, 3) what barriers prevent people from having access to the chain (i.e. barriers of entry), 4) what influences the performance of the chain and how is it conducted (i.e. governance) and 5) what is the distribution of income and profit through the chain (FAO, 2016).

Value chain analysis is basically a research method to identify opportunities to improve the performance of chains that produce food and deliver it to customers (Collins et al., 2015). A value chain analysis examines if the value chain is both effective in maximising opportunities for creating and delivering value for customers and efficient in producing and distributing products at the least cost.

As our research objective is related to the future potential of raising indigenous chickens semi-intensively, we identified possible marketing mechanisms to distribute and market indigenous chickens on a larger scale. We basically explored the current value chain for the trade and marketing of indigenous chickens raised under scavenging conditions and looked for opportunities for the marketing of semi-intensively raised indigenous chickens. However, as raising of village chickens semi-intensively is not yet widely conducted in Myanmar, we were not be able conduct a detailed value-chain analysis, but rather conducted a ‘scoping’ or a “rapid value chain approach” (Collins and Dunne, 2008; Dunne and Johnson, 2011) to describe opportunities for semi-intensive indigenous chicken production.

### 6.3.2 Data collection

In collaboration with MLF and support provided by LBVD we attempted to identify actors involved in the poultry value chain. Purposive and snowball sampling had to be used to identify key players. In particular, to identify indigenous chicken breeders and growers, a multitude of ‘search’ approaches were used, including scanning of social media content on the sale of village chicken, discussions with MLF representatives and livestock officers and follow-up phone calls to confirm that the proposed key informant was eligible. Data collection also focussed on specific locations “known” for their specific marketing of indigenous chicken products (“fried village chicken villages”) and locations where trading clusters for indigenous chickens exist.

### 6.3.3 Results and discussion of the value-chain analysis

The value chain for ingenious chickens raised under scavenging conditions is shown in Figure 20. The main channel for selling birds is through middle men, who visit villages and ‘search’ for birds at market weight that farmers are willing to sell (at a sale price of 5000-7000 Kyat). Some middle men employ informants for a small commission who find famers who want to sell birds. Few farmers sell birds directly to customers. Most middle men sell birds on to poultry traders, but some middle men sell indigenous birds also to indigenous chicken butchers, hawkers, fried chicken restaurants or street sellers or directly at poultry markets.

Growing indigenous chickens intensively and semi-intensively requires a reliable supply of day-old chicks (DOC), which need to be produced by specialised breeders (or possibly by the LBVD breeding farm) (Figure 21). Hens and roosters for the breeders of DOC should be sourced from experienced and specialised breeders of parent or grandparent flocks or from farmers raising indigenous chickens under scavenging chickens. As indigenous chickens are produced in relatively large numbers under semi-intensive conditions, and considering the ‘healthy’ and ‘green’ image of indigenous chickens, the training and use of specialised middle men in the purchase and marketing of indigenous chickens under semi-intensive conditions, should be considered. These ‘specialised’ middle men or the indigenous chicken growers themselves, should explore the full range of marketing options as shown in Figure 21.

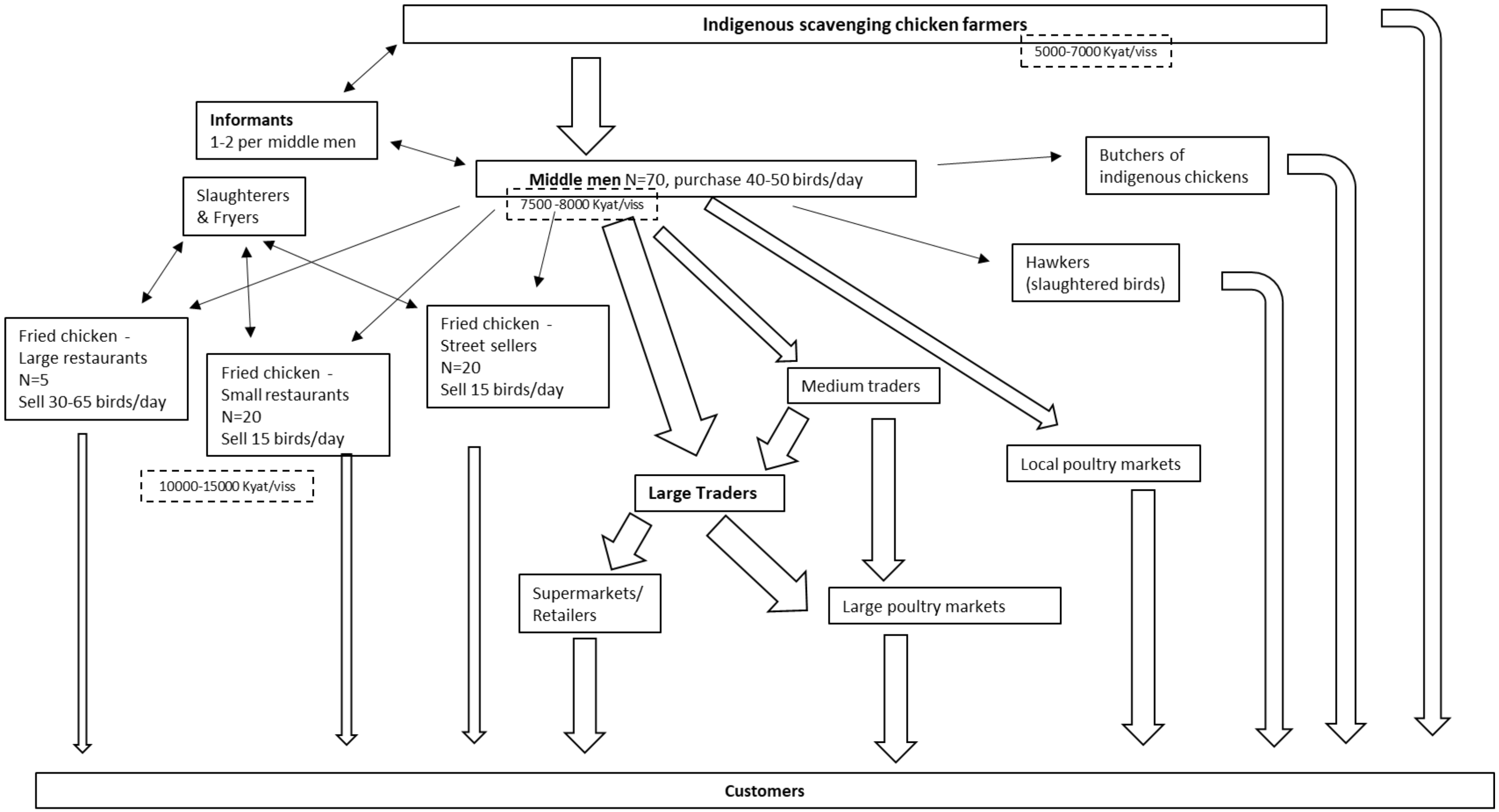


**Figure 20: Flowchart that describes the retailing channels for indigenous chickens raised under scavenging conditions.**

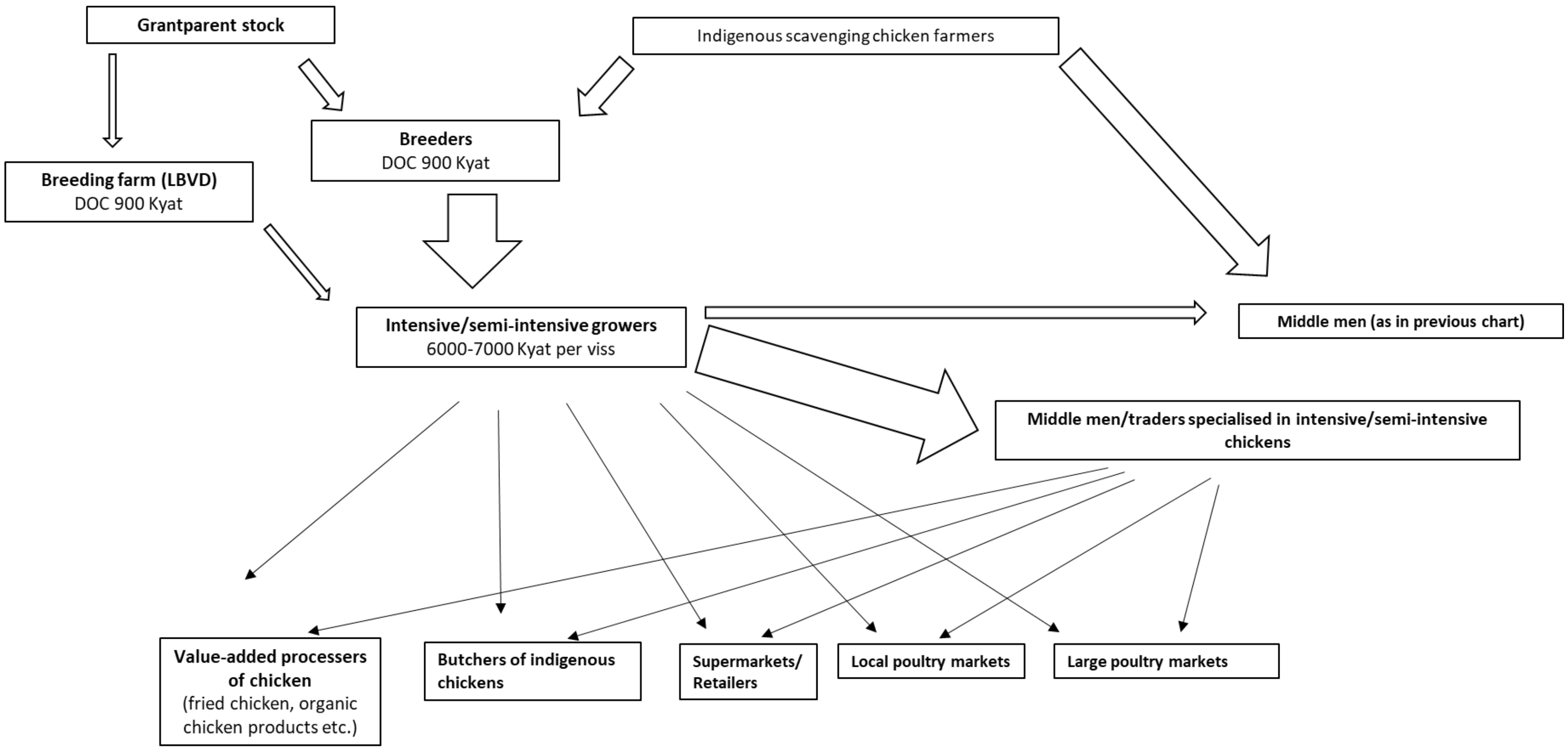


**Figure 21: Value chain map for inputs and retailing options for indigenous chickens raised under intensive and semi-intensive conditions.**

# 7 Conclusions and recommendations

Our formative and feasibility research focussed on 1) the evaluation of raising and feeding indigenous chicken breeds semi-intensively and on 2) an assessment of profitability and a value chain analysis for semi-intensive indigenous chicken production, including the identification of constraints and opportunities for semi-intensive production.

A number of trials involving evaluation of the effects of dietary composition (nutrient density and energy: protein ratio) on the performance of indigenous chickens to typical market weight were conducted. The data obtained clearly demonstrated the value of intensive housing and feeding of young chicks in minimizing the attrition rate (to less than 10%), which has a profound impact on the economic viability of production. The feeding trials demonstrated the potential of intensive production of indigenous birds to be economically viable given appropriate diets, but more work is required to define optimum nutrient composition and marketing age.

The value-chain analysis highlighted that semi-intensive production provides a profitable opportunity, but more research is required to facilitate the development of procedures aimed at i) maintaining a consistent supply of birds to farmers, ii) providing a cost-effective feeding program for indigenous chickens which optimises growth and feed efficiency, and iii) developing a more direct and practical marketing strategy for indigenous chicken products. Our research also indicated that some localised examples of diverse marketing strategies for high-value indigenous chicken products (fried village chicken') already exist, with opportunities for further expansion. However, we also identified that the high demand for indigenous chickens by customers frequently can't be met, highlighting opportunities for increased production and better marketing of these birds. Overall there was a strong interest by farmers and traders in increasing and diversifying indigenous chicken production, but a need for training and support was indicated.

The project generated a unique dataset and methodology that provides an opportunity to develop a semi-intensive production system that can be adopted by a significant proportion of small-scale farmers with limited resources, in particular women, across the whole country. Such an enterprise offers a distinctive opportunity for a first step out of poverty. Veterinary service providers and animal feed and health product and vaccine suppliers will also be important beneficiaries of semi-intensive indigenous chicken production. As village poultry plays a vital role in the livelihoods of traders, middle-men and sellers of poultry products in rural communities, semi-intensive indigenous chicken production could increase their trade volume and income. Thus, under the one-health paradigm, rural food and nutrition security could be maximized through increased numbers of chickens and eggs available in rural communities and through increased trade in peri-urban and urban communities.

There are a number of factors which determine the potential viability of intensive and semi-intensive chicken production and which need to be considered and further researched. These include breeding and genetics, housing and nutrition, quality and availability of poultry feed, and marketing of birds.

## 7.1 Conclusions

### 7.1.1 Breeding and genetics

Whilst genetics has the capacity to impact profoundly upon productivity, as seen in the development of specialized commercial meat and egg strains of chickens in Myanmar, such performance can only be achieved where nutritional and management inputs permit the expression of the birds' genetic potential.

General purpose indigenous breed (village) chickens are ubiquitous throughout Myanmar. By way of quite extreme contrast with specialized commercial strains of broilers and layers, these birds have, for the most part, considerably lower genetic potential for meat and egg production, but are able to survive, reproduce and produce meat and eggs under the often harsh semi-scavenging village environment.

According to observations by farmers and others during this project in Myanmar, there is significant variation in productivity between the various indigenous breeds and ecotypes. In considering the possible development of an intensive indigenous chicken "industry" in the country, the performance of the available ecotypes under such conditions needs to be determined.

In considering the possibility of genetic improvement of any genotype, any such improvement of stock is a significant undertaking requiring good management, accurate recording and in most cases, considerable inputs, either by the farmer or source of the breeding stock. The literature is full of reports of failed genetic upgrading and cockerel replacement programs in rural areas of developing countries.

Attempts by farmers at genetic "upgrading" of flocks through the introduction of bigger and faster growing cocks (or hens), are widespread in all developing countries including Myanmar. Whilst this generally results in an increased growth potential in the progeny, this may not be achieved due to nutritional and other limitations, particularly under extensive semi-scavenging management conditions. In a breeding, rather than simply rearing context, there may be other effects of "upgrading" upon e.g. broodiness and reproductive efficiency and performance of the female progeny.

We observed that the breeder of indigenous chickens, Mr Nyunt Win, crossed local indigenous and other genotypes to provide birds that are notionally tolerant to local conditions while also capable of reasonable performance . In the latter case, village chicken males were crossed with Rhode Island Red hens. This approach involves the need for maintaining separate parent lines/breeds for the generation of the F1 crossbred progeny. In nearly all cross-breeding programmes, the cross-bred bird exhibits considerably better egg production and/or growth rate than the indigenous breed parent.

Where crossbred progeny are to be grown under extensive semi-scavenging conditions, problems can be encountered with loss of broodiness in hens, making them incapable of reproducing naturally, and the need for additional inputs (particularly feed) to achieve the birds' genetic potential for production. Under both extensive and intensive management systems there is a potential problem with the change in appearance and "type", which may affect the birds' acceptability to farmers and, more particularly, to the consumers of poultry eggs and meat, and their preparedness to pay the significantly higher prices commanded by indigenous birds. This was something commented upon by a number of the farmers and dealers with whom we spoke.

Notwithstanding these limitations, there is a case for considering genetic improvement through crossbreeding for indigenous chicken breeds intended for intensive and semi-intensive production systems.

### 7.1.2 Management and nutrition

With the more intensive forms of management, provided basic bird physiological requirements are met, there is no reason why simple forms of housing and management cannot result in reasonable productivity. The basic requirements for poultry housing are space, ventilation, light and protection. This means avoidance of overcrowding, protection from predators and climatic extremes, ability to shelter from the sun and rain, access to clean (and preferably cool) water and access to compounded feed or feedstuffs which reasonably meet the birds' nutrient requirements. In the interests of sustainability, structures for housing and shelter should preferably be constructed from simple locally available materials. Such structures will vary considerably from region to region depending upon the environment, available materials and cultural considerations.

Because of the temperature and humidity conditions experienced in Myanmar, most commercial broiler operations utilize elevated bamboo slatted floor houses with either open mesh or slatted sides permitting airflow over the birds, and removal of the birds from contact with their excreta. This system, was successfully used in the semi-intensive trials in Meikthila and Myngyian as well as in the intensive trials in the latter location.

For breeding birds, either the same system as above for bird rearing, but with nest boxes included, or a deep litter system (using rice hulls) with smaller pens for single sire matings or larger pens with multiple males, could be effective forms of housing. The important features include good ventilation, no overcrowding and good access to food and water and nest boxes. For pens on the ground, the deep litter area (for permanent or night-time confinement) needs to be dry which involves an effective roof which excludes rain and appropriate drainage which excludes ground water.

The composting action of deep litter minimizes the risk of diseases (e.g. coccidiosis in young birds and fowl cholera in breeding stock), provided the litter is kept dry. To achieve this composting action, is important that the litter is of sufficient depth, preferably at least 70 mm. Where birds are kept in a confined space on earthen floors, there is a considerable risk of disease development. We observed rearing and breeding birds being kept under deep litter and earthen-floor systems in a number of locations.  The indications are that in most regions of Myanmar, rice hulls are generally available at a reasonable cost.

Access to and quality of feed is a critical element in semi-intensive and intensive production systems and also in the more extensive production systems where bird numbers outstrip the capacity of the SFRB, combined with the typically limited supplementary household food scraps and broken grain provided to the birds, to provide adequate nutrition. A particular problem in rural areas of developing countries in the past has been the availability of well-compounded feeds to meet the nutritional requirements of the different classes of stock, and/or the availability of quality feedstuff ingredients to use in the preparation of such feeds. There has been considerable competition with the human population for quality feed ingredients, which means that poultry feeds were often based on poor quality or alternative ingredients. The main challenges to the use of effective nutritionally balanced poultry diets were: (i) the widespread use of poor quality feedstuffs, the nutrient composition of which was often unknown, (ii) very limited information on the nutrient composition of many of the alternative feedstuffs used, (iii) limited understanding by local feed millers of the nutrient requirements of the different classes of stock and iv) adulteration of diets with non-nutritive materials like sand and sawdust. Presently in Myanmar, many of these limitations have been addressed by the ready availability of good quality poultry feed from reputable suppliers, in many locations. This has profound implications for the development of a viable intensive semi-itensive chicken production industry.

There is an increasing availability of well-compounded poultry feed throughout Myanmar. Three large companies (viz CP, De Heus and Japfa) have feed mills in Myanmar and provide bagged feed to produce stores and poultry operations throughout the country. In addition to their commercial broiler and layer diets, all three companies provide lower specification diets for use with indigenous chickens, on the (reasonable) assumption that either nutrient requirements for growing and laying indigenous chickens are lower than those of commercial broilers and layers respectively, and/or that the diet of indigenous birds is supplemented with nutrients provided by the scavenged food. As an example, De Heus offer semi-broiler” starter, grower and finisher diets approximately 2% and 200 cal/kg lower than the crude protein and ME respectively in the equivalent broiler diets.

### 7.1.3 Hatching

A fundamental requirement for effective and profitable poultry production, is good hatchability. In small-scale extensive production, this is provided by a hen of indigenous ecotype, who for the most part, is a very effective and reliable incubator and hatcher.  In intensive production, however, it is important that the hen keeps laying to produce more fertile eggs. This requires the use of artificial incubation.

In our study tour we encountered two forms of artificial incubation in use with village chickens. The first was at the breeder of indigenous chickens, Mr Nyunt Win, where a commercial 24,000 egg setter was in use. This was well run and claimed hatchability was high (>80%). The second was near Natmauk at the NGO Terre des Hommes supported project on indigenous chickens, and utilized a traditional rice incubator wherein rice was heated in a container over a fire to an estimated appropriate degree, and the eggs were placed inside woven baskets with the heated rice. The process was repeated regularly until hatching at about 21 days of incubation. It is not clear as to what the exact criteria used to determine appropriate temperature was based upon, but hatchability was low (approx. 35% of all eggs set). On the reasonable assumption that fertility was high (typically >95%), there would appear to have been a significant problem with the incubation system as used. Indications based on age of death of embryos, and types of embryo malformations, suggested that the temperature, particularly in the late phase of incubation, was too high. This information and suggestions for correction, were passed on to the NGO personnel following our visit.

Given the above experiences, with the increasing availability of reasonably reliable electrical power in Myanmar, it would seem that any medium to large-scale intensive breeding operation with village chickens, should employ the use of a commercial incubator of appropriate size, the location of which should be determined by the availability of a reliable power source.

### 7.1.4 Marketing & consumer preferences

Notwithstanding their relatively poor genetic potential for growth compared to broiler chickens, there is a considerable potential in Myanmar for indigenous chicken breeds/ecotypes to be reared intensively or semi-intensively due to the high demand for, and the high price commanded by these birds in the market place. It is not uncommon for indigenous chickens to fetch 6000-8000 kyat/viss compared to around 3000 kyat/viss for broilers. However, there are very few intensive or semi-intensive breeding or growing operations in the country and those that are present are for the most part relatively small-scale.

The globalisation of food markets and trade are creating a new competitive environment for primary producers, food manufacturers and retailers (Collins et al., 2015). There is also a stronger focus on consumer choice, in particular creating value in the eye of customers (Wright and Lund, 2003 in Collins et al). While in developed countries, the retailer are often in control in responding to and expanding consumer choice, value chains for indigenous poultry in developing countries are more complex with producers also directly supplying customers and providing producers with opportunities to directly market high-value poultry products to customers.

Innovative approaches for indigenous poultry production can be regarded as a chance to create a new product, process, market or management approach for the purpose of increasing profit for producers, but also providing benefits to consumers and other value chain actors (traders). Our value chain analysis exhibited windows into performance improvement opportunities. Performance might be improved by enhancing particular subsystems (or interactions between them), for example by setting-up breeding facilities for ingenious chickens to be raised under intensive and semi-intensive conditions, by more direct marketing of indigenous chickens to restaurants and specialised butchers, or by better branding of indigenous chickens as organic or as healthy animal protein

Overall, we were able to show that intensive and semi-intensive production using indigenous chickens provides a very real opportunity for meeting the burgeoning demand in Myanmar for clean/ green /organic products.

## 7.2 Recommendations

Considering the monetary value of indigenous birds in Myanmar and the burgeoning demand for clean, green and organic products, there is real opportunity to 1) develop methodologies to set-up entrepreneurial business opportunities for small-scale farmers to increase their income from the sale of high-value indigenous chicken products, 2) empower women who constitute the majority of small-scale poultry farmers and 3) establish environmentally sustainable chicken farming practices aimed at improving livelihoods of rural communities (including traders) and improving Myanmar's food security.

We recommend that further research needs to be conducted to develop a production and marketing strategy for high-value indigenous chicken meat and egg products in Myanmar and potentially in other countries in the region with similar environmental and infrastructural conditions. Such research should focus on the:

- Development of an optimal husbandry and management strategy to raise and maintain economically viable indigenous chicken flocks under semi-intensive conditions. An important element in this is the determination of the broad nutrient requirements of the different breeds and ecotypes of village chickens at different stages of growth.
- Development of husbandry practices and marking strategies to produce high-value commodity items derived from village chicken production (e.g. organic meat and eggs)
- Development of a sustainable marketing strategy to improve market participation, in particular to ensure that all stakeholders in the market chain have economic incentives to work with small-scale farmers
- Development of strategies to adopt and maintain sustainable indigenous chicken production that is resistant to shocks in the value chain (e.g. disease occurrence, feed price fluctuation)
- Capacity building of farmers and traders in ethical, sustainable and profitable indigenous chicken production
- Exploration of opportunities for developing a capacity to produce sufficient quantities of high-value indigenous chicken products for domestic and possibly international markets
- Research into the establishment of breeding facilities for indigenous breeds and the reliable and consistent supply of chicks to farmers
- Research into health, ethical and biosecurity requirements for semi-intensive, organic and low-environmental impact production of indigenous chickens
- Research into the impact of semi-intensive production on consumer preferences for indigenous chickens (e.g. consumer's perceptions on feeding and confinement of birds and on taste of meat and eggs produced under semi-intensive conditions)
- Research into marketing tools for indigenous chicken production (e.g. instant price info via mobile apps, social media advertising)
- Economic modelling of value chain shocks or fluctuations that impact on profits derived from indigenous chicken production
- Research into improved networking opportunities between farmers and traders
- Training of farmers and other value chain actors (e.g. traders) in production and marketing strategies for high-value indigenous chicken meat and egg products

# 8 References

## 8.1 References cited in report

Collins, R.C., Dent, B., Bonney, L.B., 2015. A guide to value-chain analysis and development for Overseas Development Assistance proejcts. Australian Centre for International Agricultural Research Canberra, ACT.

Collins, R.J., Dunne, A.J., 2008. A Rapid Supply Chain Appraisal Approach for Agribusiness Development Projects. Acta Hortic, 73-79.

Dunne, A., Johnson, P., 2011. The Rapid Supply Chain Appraisal Approach: a Case Study of Pakistan Mangoes to the United Kingdom. Acta Hortic 895, 107-112.

FAO, 2016. Economic Analysis of Animal Diseases. Food And Agriculture Organisation Rome.

## 8.2 List of publications produced by project

Pym, R.Y.M, Henning, J., 2019. The economies of intensive and semi-intensive production of village chickens. Conference proceedings. Pan-African Poultry Congress (PPC), which will take place from 13 to 17 May 2019 in Lome, Togo.