



Village Poultry Production Systems in the Central Highlands of Ethiopia

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ABSTRACT

Participatory rural appraisal (PRA), supported by checklists and intensive case studies on individual households, was carried out in three villages at three different altitudes in the central highlands of Ethiopia. The chicken production system in each village is described and the problems are discussed. More than 60% of the families kept chickens, and in most cases the women owned and managed the birds and controlled the cash from the sales. The production systems followed were mainly low-input and small-scale, with 7–10 mature birds per household, reared in the back yards with inadequate housing, feeding and health care. The average egg production per clutch was 15–20, with 3–4 clutches per year. The mean number of eggs set per bird was 12.9 ± 2.2 ($n = 160$), depending on the size of the bird and season, and the hatching rate was $80.9\% \pm 11.1\%$, range 44%–100% ($n = 160$). Poultry meat and eggs were generally accepted and appreciated in all three villages. In addition to the small amount of cash income they provide, scavenging chickens have nutritional, cultural and social functions. The flock composition, price of poultry and poultry products, disease outbreaks and hatching of chicks were strongly affected by season. Disease was cited as the most important problem by most of the members of the community, followed by predation, lack of feed, poor housing, insufficient water and parasites. Disease periodically decimated the flocks, and consequently, about 50% of the eggs produced were incubated in order to replace the birds that had died. The major source of loss in the system was the high mortality of chicks (61%) that occurred between hatching and the end of brooding at 8 weeks of age. The system was characterized by no or few inputs and a low output level. The major input was the cost of foundation stock, but after that virtually no cost was involved. The major source of feed for the birds was from the scavenging feed resource base, which comprised table leftovers, small grain supplements and anything edible from the immediate environment.

Keywords: disease, mortality, nutrition, poultry, productivity, scavenging, village

Abbreviations: ANRPD, African Network for Rural Poultry Development; asl, above sea level; ILCA, International Livestock Centre for Africa; PRA, participatory rural appraisal; SAREC, Swedish Agency for Research Cooperation with Developing Countries; SFRB, scavenging feed resource base

INTRODUCTION

The development of innovative ideas for improving rural poultry production requires a complete understanding of the system and its operators. Furthermore, research directions and strategies should be geared to addressing the farmers' real problems

and constraints so as to help them expand and become self-sufficient. This in turn requires careful and detailed analysis and understanding of farmers' circumstances and practices before undertaking any other research and/or development activity. For example, the purpose for which a farmer keeps poultry determines his or her management practices. On the other hand, as summarized by Röling (1988), the development and transfer of appropriate technologies should be a function of the farmers' socio-economic and management practices at the field level. Hence, an important element in the sustainable development of a community is the active involvement of the community members in any development activity, which should start with their participation in identifying their problems and constraints, and in deciding on the best alternatives and most appropriate strategy to meet such needs.

There is, therefore, a need to acquire baseline data on rural poultry production in selected areas, and the survey reported here was undertaken with the following objectives: (i) to describe the biophysical, economic and sociocultural aspects of poultry production in the selected communities; (ii) to identify and analyse with the residents the problems and constraints impeding the development of their community, with particular emphasis on poultry production; (iii) to list together with the residents the possible opportunities and strategies that could solve these problems; (iv) to suggest possible entry points for introducing sustainable poultry developments to the area.

MATERIALS AND METHODS

The villages

The study was carried out in the central highlands of Ethiopia, in three villages, at three different altitudes, including Derek Wonz (high, 2850 m asl), Gende Gorba (medium, 1850 m asl) and Awash (low, 1550 m asl), and in three seasons, dry, short rains and main rains. These three sites are in the high-potential cereal/livestock (Gende Gorba) and the low-potential cereal/livestock zones (Derek Wonz and Awash) of the highlands. In the central highlands, the main rainy season lasts 4 months (June to September), the dry season lasts about 6 months (October to February), and there is a short rainy season (March to May).

Baseline data collection

Participatory rural appraisal (PRA)

It is essential in any agrosociological survey to gather basic first-hand information with regard to the farmers' circumstances and production practices. To this end, topical PRA techniques were applied using both a checklist adopted from a draft training manual for baseline data collection on rural poultry production (ANRPD, 1995) and a year-round case study in individual households. The exercise was carried out three times in one year to determine the effect of season. With the participation and

assistance of the key informants and community members, the main issues of poultry production, including the current status of poultry in the community, the relation of poultry keeping to the wealth of each household, the problems encountered in poultry production in each of the villages, the role of each family member in poultry keeping and, finally, the opportunities for improving poultry production, were identified and ranked or prioritized. Other socioeconomic aspects, such as the cultural roles of poultry production were also covered. In order to confirm the information, the final exercise was a transect walk in and around the residential quarters of the villages to observe at first hand all aspects of poultry production in individual homesteads and to discuss these matters with the wives, as their participation in the village meetings was minimal. After doing this and organizing the information, the group (two researchers and a development agent from the Ministry of Agriculture) presented the findings to the community at a second village meeting and, after lengthy discussions and many corrections, the community finally agreed with the conclusions. Then, according to the plan developed by the group and accepted by the community, year-round data collection was started together with the villagers in order to understand the flock dynamics, marketing and other aspects of poultry production in each of the three villages. In addition, some of the issues required in-depth analysis and were treated separately in case studies.

Case study

Year-round case studies were carried out in individual households in the three villages in order to arrive at a detailed understanding of the circumstances and attitudes of farm households on a year-round basis. These in-depth analyses were carried out to gather information on key issues of poultry production, such as feeding, breeding, general management, changes in flock size, trends in ownership, constraints on production, marketing and consumption and the current importance of poultry as a source of food and cash income for the farm households. In addition, cultural practices in relation to poultry production and the reasons for keeping poultry in each village were determined.

RESULTS

Objectives of poultry keeping

The main objectives of keeping poultry (Table I), as given by the villagers, were the production of eggs for hatching, sale and home consumption, and production of birds for sale, sacrifice (healing ceremonies), replacement and home consumption. Some farmers give live birds and eggs as gifts, and invite special guests to partake of the popular dish *doro wat*, which contains both chicken meat and eggs and is considered to be one of the most exclusive national dishes. In all three villages, it was mostly the women that owned and managed the birds and controlled the cash from sales, followed by school boys and girls.

TABLE I

Use and perceived benefits of chickens and eggs to families in 10 households in each of three villages in the central highlands of Ethiopia (means, SD, percentage and range)

	Mean \pm SD (30) ^a	Percentage	Range
<i>Eggs</i>			
Sale	21 \pm 7	23	10–41
Consumption	19 \pm 7	20	5–34
Gifts	5 \pm 3	5	0–36
Incubation	49 \pm 14	52	13–73
<i>Chickens</i>			
Sacrifice	3 \pm 1	25	0–6
Sale	3 \pm 2	27	0–8
Consumption	2 \pm 2	20	0–6
Reproduction	3 \pm 2	20	0–6
Gifts	1 \pm 1	9	0–3

^aNumber in parentheses represents the number of households surveyed (10 households in each village)

Flock characteristics

The overall mean flock characteristics in each household in the three villages are given in Table II. The common breed type was the indigenous chicken and, although there had been some introduction of exotic breeds to the villages at various times and in different forms, such as cockerels, pullets or fertile eggs, their impact in upgrading the village chickens had been minimal. The villagers mostly bought their foundation and replacement stock from acquaintances, or from the market if there was no outbreak of disease in the area. In some cases, they got foundation stock from relatives as gifts, particularly if they were newly married or new settlers. The male-to-female ratio in the flocks was 1:3 to 1:4 in most cases, although some of the families kept additional double-combed male birds with special colours for cultural purposes. The flock numbers and composition varied according to season and altitude (Table III).

Housing

Usually, there was no special housing provided for the birds. In most cases (88.5%) they roosted inside the family dwelling at night, the roost being made of two or three raised parallel planks of wood. A few households (11.5%) had constructed a small enclosure outside the house, and this night shelter was occasionally cleaned by the housewife, depending on her workload.

TABLE II

Flock composition by age in three villages in the central highlands of Ethiopia in 1995 (overall mean/household, SD and range)

Class of bird	Mean \pm SD number per household (60) ^a	Range (60)
Chicks (0–8 weeks)	5 \pm 3	0–19
Pullets (8–20 weeks)	3 \pm 2	0–11
Cockerels (8–20 weeks)	3 \pm 2	0–7
Cocks (mature)	1 \pm 1	0–5
Layers	3 \pm 1	0–6

^aNumbers in parentheses represent the number of households surveyed (20 households in each village)

TABLE III

Flock composition by season and age group in the three villages in the central highlands of Ethiopia from January to December 1995 (mean and SD)

Village/age group	Short rains	Rains	Dry
<i>Derek Wonz</i> (20) ^a			
Chick	6 \pm 4	3 \pm 2	2 \pm 3
Pullet	4 \pm 2	2 \pm 1	1 \pm 1
Cockerel	2 \pm 2	2 \pm 1	1 \pm 2
Cock	1 \pm 1	2 \pm 1	1 \pm 1
Layer	3 \pm 1	3 \pm 1	3 \pm 1
<i>Gende Gorba</i> (20)			
Chick	5 \pm 4	3 \pm 3	6 \pm 2
Pullet	4 \pm 3	2 \pm 2	3 \pm 2
Cockerel	3 \pm 3	2 \pm 2	3 \pm 2
Cock	1 \pm 1	1 \pm 1	2 \pm 1
Layer	3 \pm 3	3 \pm 1	3 \pm 1
<i>Awash</i> (20)			
Chick	6 \pm 4	4 \pm 3	16 \pm 4
Pullet	4 \pm 2	3 \pm 2	4 \pm 2
Cockerel	3 \pm 1	3 \pm 2	3 \pm 2
Cock	2 \pm 1	1 \pm 1	2 \pm 1
Layer	3 \pm 2	2 \pm 2	3 \pm 2

^aNumbers in parentheses represent the number of households surveyed

Production and productivity

The average age at start of lay and mean body weight at start of lay are given in Table IV. The egg production per clutch was 15–20, with 3–4 clutches per year. The average number of eggs set per bird depended on the size of the bird and season. The farmers reported that they were not interested in setting eggs immediately before the onset of the rainy season because of the risk of spoilage of eggs owing to the cold weather and the mud that comes in with the hen when she returns from scavenging. Therefore, the farmers were reluctant to set eggs for hatching from mid-June to mid-September in Gende Gorba and Awash and up to the end of October in Derek Wonz. In addition, the farmers in Derek Wonz (high altitude) were also unwilling to set eggs at the beginning of the dry season because of the risk of frost. Farmers normally preferred to set eggs 6 months prior to holidays to take advantage of the high prices for meat birds. About 88% ($n = 160$) of the farmers only set odd numbers of eggs, owing to a belief that this increases the chance of a successful hatch.

TABLE IV

Weights of chicks at hatch, at 8 weeks of age and at start of lay, and age at start of lay in three villages in the central highlands of Ethiopia (mean, SD and range)

	At hatch (g)	At 8 weeks of age (g)	At start of lay (g)	Age at start of lay (days)
Mean \pm SD (n^a)	28 \pm 4 (60)	185 \pm 13 (23)	1035 \pm 34 (19)	195 \pm 28 (19)
Range	18–36	152–213	985–1113	183–215

^aNumbers in parentheses represent the number of hatches surveyed

Chick mortality was high in the first two months after hatching (Table V), and higher when there was a disease outbreak in the area. Generally, it was difficult to associate this high mortality with a single factor as it was a result of a combination of several factors, including disease, predation, feed deficiency and the hostile environment encountered by the newly hatched chicks. The body weights of chicks at hatch and at 8 weeks of age are given in Table IV. The source of eggs for hatching could be from the farmers' own layers or, if these were insufficient, by buying from neighbours and/or relatives, particularly if the performance of their hens was good from the point of view of the productivity, size of the eggs and conformation of the mother birds.

In the case of birds used for hatching, the hens were often selected on the basis of their past performance. Equipment used for setting eggs was either clay pots, called *dibignet*, cartons, bamboo baskets or even simply a depression in the ground. The

TABLE V

The number of eggs set per clutch, hatched, percentage hatch, mortality and percentage mortality at 8 weeks of age, and range, in the three villages in the central highlands of Ethiopia (overall mean/household, SD and range)

	No. eggs set	No. hatched	Percent hatched	Mortality at 8 weeks of age (no.)	Mortality at 8 weeks of age (%)
Mean \pm SD (<i>n</i> ^a)	13 \pm 2.2 (159)	11 \pm 2.3 (159)	81 \pm 11 (159)	6 \pm 2 (159)	61 \pm 17 (159)
Range	7–19	4–16	44–100	0–12	0–100

^aNumbers in parentheses represent the number of hatches surveyed

bedding materials used in all systems of setting were crop residues, usually *tef* (*Eragrost tef*) and wheat straw. The families incubated most of their eggs in order to replace the birds from their flock that had been sold or consumed, or those that had died. Generally, the hatchability of the set eggs was relatively high, but the chick mortality was also very high (Table V), more than 60% in the three villages.

The mother hen stayed with her brood up to 2 months of age of the chicks. although some farmers set eggs under two birds at the same time and then, after hatching, gave all the chicks to one of the hens. The other hen was then subjected to special treatment to stimulate egg production. Under normal circumstances, once the birds became broody they remained so for about one month and attempted to incubate their eggs. Traditionally, the farmers used one of three different methods to stimulate the bird to start laying again, the basis of all of the methods being to disturb the bird. For example, they pierced the nostrils with a feather to prevent it sitting, moved the bird to a nearby house for 5–10 days, or hung it upside down for a limited period (for 3–4 days). After the bird loses its broody behaviour, it usually starts to lay eggs again within 8–10 days. The productivity of the birds was also related to season, the farmers always expecting higher egg production after the grain harvest and at the time of land preparation and sowing.

Management and feeding

The feed resource base (FRB) for the village flock was scavenged material from the immediate environment, food leftovers and small amounts of grain provided by the housewife (Figure 1). The food leftovers were more or less constant throughout the year, but the portion of the FRB derived from the environment and the grain supplement varied with seasonal conditions and with activities such as cultivation and harvesting. The birds scavenged from morning to evening, except around midday in

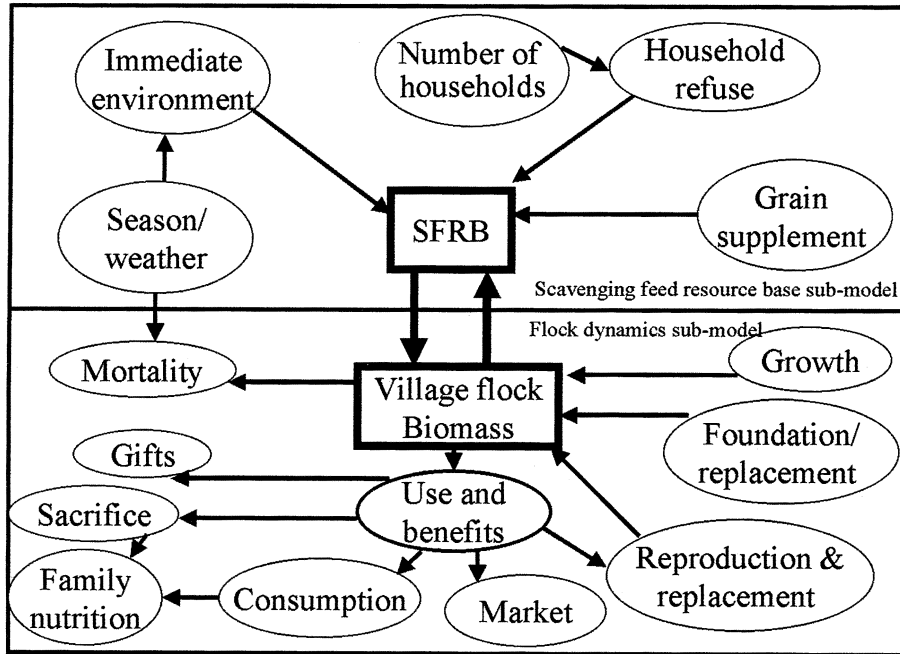


Figure 1. A pictorial model of the scavenging village chicken production system in the cultural highlands of Ethiopia

hot sunny conditions and on very rainy days. However, the diet composition varied according to the housing density and the flock biomass in the village and in the neighbourhood.

In a few cases, the housewife provided a preferential feed supply for chicks. This might be boiled *tef* grains or water soaked *injera* (a pancake made of fermented *tef* flour), which was given in a conveniently placed container until they started to scavenge with the mother hen. There was usually no regular provision of clean water for mature birds, although in some households the mother hen and her chicks were provided with water in broken clay pots until they start to forage by themselves.

Health management and disease control

Disease was cited as the most important problem by most of the members of the community with whom it was discussed, reducing both the number and productivity of the birds (Table VI). Some farmers had given up rearing poultry because of an increase in disease problems after villagization (1984–86), when the close contact of different flocks from different households in the more densely populated areas facilitated

TABLE VI
Ranking of constraints and problems of village poultry production in the three study villages as perceived by the community members

Constraints/ problems	Derek Wonz (high altitude)	Gende Gorba (medium altitude)	Awash (low altitude)
Disease	***	***	***
Extension	***	***	***
Predators	***	**	**
Shortage of feed	**	**	**
Productivity of birds	*	*	**
Housing	**	**	*
Parasites	***	*	**
Money	*	*	*

***Major problem/constraint, **Fairly serious problem/constraint, *Not serious

transmission of communicable diseases, in addition to the problem of increased competition for the limited resources (Figure 1). The relationship between disease and flock density was apparent in the rural areas, some farmers in non-villagized areas not having had any experience of recurrent disease outbreaks and considering that their birds were more vigorous and productive than the flocks in the larger villages.

The general feeling of the villagers was that the problem of disease is getting worse and many said that they had not encountered such problems prior to their resettlement. The other problem associated with villagization was frequent quarrelling among neighbours due to damage by poultry to vegetable gardens. The signs of the common diseases as perceived by the community in the three villages were loss of appetite, reduction in drinking and eating, watery and yellowish droppings, paralysis and, consequently, death. This syndrome was called *enkuref* by the community in Derek Wonz village and *fengle* in Gende Gorba and Awash villages. This disease, which was probably Newcastle disease, was an acute condition, lasting for only 3–5 days, and usually resulted in the death of the whole flock because transmission was very rapid. Before the villagization programme, outbreaks of this disease usually occurred at the beginning of the rainy season, that is at the end of May and beginning of June, but after villagization it became a problem throughout the year, even though it was still more serious at the beginning of the rainy season.

The farmers did not have any preventive medicine or practice for this fatal disease and only treat their birds with accepted traditional medicines after the start of an outbreak (Table VII). However, the effectiveness of these treatments was not satisfactory.

The major external parasite in the area was mites, for which the only traditional remedy used by farmers was wood ash rubbed into the feathers. The farmers also

TABLE VII
Medicines used for health management in the three villages

Local name	Scientific name	Usage	Village	Remark
Feto	<i>Brassica</i> spp.	<i>Fengle</i> and <i>enkuref</i>	All	
Wood ash		External parasites	All	
Human antibiotics		All diseases	All	Drinking water
Eucalyptus leaves	<i>Eucalyptus</i> spp.	All diseases	All	Juice
'Emenet' (holy soil)		All diseases	Derek W.	Dipping and drinking water
Hot pepper	<i>Capsicum frutescens</i>	All diseases	All	Drinking water
'Kencheb'	<i>Eufofoaya</i> spp.	All diseases	Gende G. and Awash	Juice extracts in drinking water
Edible oil		All diseases	All	In drinking water and feed
Lemon		All diseases	All	In drinking water
Garlic		All diseases	All	In feed
Other 'herbs'		All diseases	All	Juice

complained about an internal parasite called *koso*, which was probably a roundworm (*Ascaridia* sp.).

The community ranked the disease and parasite problem in the order *fengle* or *enkuref*, *kenkene* (mites) and *koso* (worms) on the basis of importance. The most important causes of mortality were disease, parasites, predators such as vultures, wild cats and rats, and physical accidents (e.g. being run over by traffic).

Marketing, economics and social aspects

Over 60% of the villagers kept chickens during the study period, and almost all those in the three villages had kept birds at some time in their life. None of the households in any of the villages kept written production records of their flock. The farmers sold live birds and eggs, particularly during holidays and festivals, and live birds were also sold at the onset of local disease outbreaks to prevent anticipated financial losses. In such circumstances, the prices fell dramatically owing to the high supply of birds relative to demand. Farmers also sold birds when they needed to meet a cash requirement for some small household expenditure. Eggs were stored inside grain storage sheds, with the intention of increasing the shelf life of the eggs until the time came for sale or consumption, which was explained by farmers as being due to the lower temperature of the grain.

Income generated from the sale of birds and eggs was for general household use. Birds were normally managed by housewives, children or family elders, and were usually sold in local markets, but occasionally to middlemen from the larger towns and cities. All the birds brought to the market were sold, whatever the price, because the farmers were reluctant to reintroduce them to the flock owing to the high risk of disease transmission.

The prices consumers paid for local birds of around 1.25 kg live weight, and small local eggs of around 40 g, were the same as those paid for commercial broiler chickens of more than 1.5 kg and larger eggs of about 60 g from commercial layers. The premium price for local eggs and birds was attributed to better flavour, and the deep yellow yolk and flesh colour, which were considered to indicate better nutritive value, in particular the yellow abdominal fat.

The contribution of poultry and poultry products to the household cash income was difficult to assess but was probably second to grain in importance. The sale of small ruminants was at one time the second most important income source, but their numbers have declined owing to shortages of grazing land.

The wealth of the villagers influenced poultry production, the rich and the medium wealthy farmers owning larger numbers of birds compared to poorer members of the village. However, they also had different reasons for keeping poultry, as wealthier families kept birds as a sideline activity, the products being mainly for home consumption, with only a very small proportion for sale or hatching. On the other hand, the poor kept their birds for the generation of income from sales, and devoted more time and effort to management. Birds were usually owned by women or school children in the rich families, and the rest of the family normally paid little attention to

the birds; in the case of poor families, where the responsibility was shared equally, the money generated was for general household use. In the richer families, the income from poultry was often used by the school children. The study revealed that the women had considerably more knowledge about poultry and poultry production than the men.

For a better understanding of the role of poultry in the society, it was necessary to know exactly the purposes for which the households kept poultry. In the villages studied, the households also kept birds for purposes other than for sale and consumption, in particular for use as sacrifices (Table VIII). The colour, sex, comb type and age of the birds used for sacrifice were very important, as was the commitment of an individual to a particular spiritual being or cosmic force. In some cases, live birds were also kept for spiritual uses, and never intended for consumption. If the bird was female, she was allowed to lay eggs, which were not consumed but were sold in the market. Apart from these cultural beliefs, traditional 'doctors' prescribed a sacrifice or keeping a live bird to cure a sick person or, for example, to ensure a safe journey. Sacrificed animals were usually consumed, but some members of the family, often the women, refused to eat the meat. Birds of exotic origin were not accepted for sacrifice.

TABLE VIII

Colour and sex of birds^a used for sacrifice and other cultural purposes in the central highlands of Ethiopia

Sex and colour of bird	Village			Purpose	Remarks
	Derek Wonz	Gende Gorba	Awash		
White cock	+	-	-	Good harvest and good rains	October and May
Red cock	-	+	+	Good harvest and good rains	October and May
Red and black spotted cock	+	+	+	Ethiopian new year	Middle of September
White and black spotted cock (<i>gebsema</i>)	+	+	+	Protection from evil things such as disease	Any time if needed
White pullet	+	+	+	To keep in the house	Any time if needed
Red pullet	-	+	+	For ancestors (<i>attete</i>)	June or May

^aThis is in addition to the prescription by 'traditional' doctors

Capital was only required to buy the first foundation of stock. There was no need of cash to buy feed or other inputs, although lack of money was still cited as a factor which could limit the size of existing flocks and prevent the poorest people from keeping poultry. Farmers sold some of their birds before the expected disease outbreaks in June, and attempted to restock in September. However, they might lack the capital to do this, although some farmers overcame this problem by sharing birds with relatives or neighbours, on the understanding of sharing the outputs.

Constraints on village poultry production

In the process of baseline data collection, the farmers were asked to list all the limiting factors on poultry production in the area. The primary problem cited was the high mortality of chicks. The major causes of this problem, as perceived by the community and in their order of importance, were disease, predation, lack of feed, poor housing and parasites. Insufficient water was also one of the causes of mortality in chicks and older birds and a contributing factor to low productivity. Predators were listed alongside disease as a major cause of premature death, and many farmers had suffered serious losses due to predation. This predation is strongly associated with the rainy season, and the predators can be divided into two categories: first, those preying only on chicks, primarily birds of prey such as vultures, and second those preying on mature birds as well as chicks, including wild mammals, generally termed wild 'cats' and 'foxes'. Predation was highest in the rainy season because of the high density of vegetation, which attracted and provided cover for predator animals. Although these constraints were year-round problems, their interaction during the rainy season was economically important.

Disease and lack of feed were reported to be the most limiting factors to village poultry production during the rainy season, and high instances of predation have also been linked to this period. The prevalence of such problems accounts for the general decrease in the number of birds in the flocks at this time of the year, and it was the combined influence and interactions between these factors that was held responsible by farmers for this decline, as opposed to any single cause. Feed deficiency and malnutrition weakened the birds and made them more vulnerable to predators and also increased their susceptibility to disease. During this period the birds needed to travel longer distances to find food, which also made them more vulnerable to predators and resulted in contact with other flocks, which facilitated the transmission of disease.

DISCUSSION

The survey results reported in this study are similar to those recorded for scavenging birds in other studies in Ethiopia and elsewhere. The main objectives of poultry production in the central highlands of Ethiopia are similar to those described by AACMC (1984), Teketel (1986) and Alemu (1995) in rural Ethiopia and by Van Veluw

(1987) in Northern Ghana and Sonaiya and colleagues (1999) in Africa. In the central highlands of Ethiopia, in addition to the small amount of cash income provided, scavenging chickens have nutritional, cultural and social functions. However, it is very difficult to determine which is the most important purpose owing, for example, to the difficulty in comparing the spiritual benefit of sacrifice with the financial benefit of sale. Guèye (1998) estimated that, in rural areas of sub-Saharan Africa, more than 70% of chicken owners were women, which proved to be true in this study. The typical numbers of birds per household in the 1980s was 10–15 in all three villages (personal communication from the community), but this has decreased to 4–10 birds per household today, mainly due to the villagization programme in the 1980s.

Roberts (1992) suggested determining the capacity of the scavenging feed resource base (SFRB) in relation to the village flock biomass. If the village flock biomass is greater than the capacity of the SFRB, there will be increased mortality of chicks and other weaker members of the flock. Above all, the quality and quantity of the feed resource is seasonal in nature and, according to Savory (1989) and Cumming (1992), the diet of scavenging poultry is usually adequate in protein but deficient in energy. This is especially true in Ethiopia in the rainy season, owing to the abundance of large numbers of invertebrates, but the protein supply may be critical in the dry season. However, after the end of the short rainy season in April–May, the amount of available grain decreases, so the birds then have to rely on scavenging only, even though the farmers agree that scavenging alone does not provide enough food. The absence of a supplement in the diet of the birds in the rainy season results in a dramatic decline in the production of eggs, due primarily to a lack of energy (Tadelle Dessie, 1996). A lack of water can seriously retard growth and impair egg production, and the water supply is especially important in tropical countries (Feltwell and Fox, 1978; Smith, 1990).

Newcastle disease is the most important disease in rural poultry production in the tropics (Sonaiya, 1990; Cummings, 1992). After summarizing reports from six African countries, Sonaiya (1990) concluded that the mortality caused by Newcastle disease ranges from 50% to 100% and that season has an effect, because the severity is higher in the dry season. However, this condition was found to be more severe in the rainy season in the central highlands of Ethiopia.

As described by Cummings (1992), the present system is inefficient in that disease periodically decimates the flocks and about 50% of the eggs produced have to be incubated in order to replace birds that have died and, together with the huge mortality of young chickens, this is extremely wasteful. The time lost when the hen incubates her eggs (21 days) and broods small chicks (45–56 days) represents a considerable loss of egg production and eggs hatched that could have been consumed by the family or sold to generate cash income for the household.

CONCLUSIONS

Poultry occupy a unique position in rural areas through their ability to supply valuable high-protein food to the families of rural smallholder farmers. This is particularly true in the study areas because there are few alternative animal protein sources, there are

few cultural or religious taboos of any kind relating to the consumption of eggs and poultry meat, and poultry keeping is one of the most appropriate income-generating activities for rural women and for landless and marginal farmers. Poultry provide cash income, generate employment opportunities and at the same time increase the supply of high-quality animal protein. Scavenging poultry are particularly appropriate because they do not compete for those foodstuffs that humans can eat directly, so that this is a system that makes the best use of locally available resources.

The requirement now is to improve these production systems in order to make the best possible use of those resources and it is suggested that the capacity of the local SFRB should be estimated, so that it is possible to determine the biomass that could be supported by the resource. This would help to reduce the intraspecific competition that causes a high mortality in chicks and other weak members of the flocks. In rural poultry production, Newcastle disease appears to be the most important disease, but there are no records of conventional Newcastle vaccines being used to protect the birds in Ethiopia. The problem is that refrigeration is required to maintain the viability of the vaccine virus during distribution and the cost involved in catching and vaccinating widely spaced small flocks is also a major obstacle. However, the Australian V4 feed-supplied vaccine that has been produced at Debre Zeit and tested successfully in village trials in Ethiopia may well be the answer to this problem, in that it is far more tolerant of poor storage conditions (Cummings, 1992; Nasser *et al.*, 1998). Regular vaccination, provision of night shelters and water, and improved feed supplementation from locally available resources, should increase egg production from local birds. Above all, it is important to make poultry producers aware that there are such options and that it is possible to increase the benefits from local birds with small additional inputs and improvements in management. Otherwise, the villagers perceive these scavenging birds as natural low-grade animals that are not considered to represent wealth, because they cost nothing, and high losses are considered as normal. However, these birds can provide very valuable products and are a source of cash income for the women and school children. Above all, poultry are the only affordable animals to be slaughtered for consumption for the resource-poor farmers. Finally, it should be pointed out that rural poultry production has received little or no attention from animal breeders, veterinarians, planners or senior policy makers. Attention should be given to the development of village poultry production systems with respect to the particular socioeconomic and agroecological conditions of the country, and further specific studies are needed to find out which are the best production systems and development strategies.

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Systèmes de production avicole en milieu rural dans les plateaux du centre de l'Éthiopie

Résumé – L'évaluation de la participation rurale (PRA) fut suivie par des vérifications par listes et par des études de cas pour des petits producteurs individuels dans trois villages de trois altitudes différentes des plateaux du centre de l'Éthiopie. Le système de production et les problèmes rencontrés sont ici discutés. Plus de 60% des ménages gardèrent des poulets et dans la plupart des cas les femmes s'occupaient des élevages et géraient les finances liées à ce système de production. La majorité des productions furent à une échelle réduite et avec une productivité faible. En général de 7 à 10 volatiles étaient gardés derrière la maison dans des conditions inappropriées de nourriture, d'hébergement ou de santé animale. 3 à 4 couvées étaient obtenues chaque année avec de l'ordre de 15 à 20 oeufs par couvée et par maison. La moyenne des oeufs pondus par oiseau était de $12,9 \pm 2,2$ (160 échantillons) en fonction de la taille de l'oiseau et de la saison. Le taux d'éclosion était de $80,9\% \pm 11,1\%$, variant de 44 à 100% (160 échantillons). La viande de poulet et les oeufs étaient en général très appréciés dans chaque village. En plus de l'avantage financier de cette production les poulets nourris en liberté ont des intérêts nutritionnels, culturels et sociaux. La composition des élevages, le prix des volailles et des produits dérivés, les maladies et le taux d'éclosion des poussins furent grandement influencés par la saison. Les maladies furent le problème principal mentionné

par la majorité des éleveurs, en suite c'était les prédateurs, le manque de nourriture, les faibles conditions d'hébergements, le manque d'eau et les parasites qui préoccupaient le plus les éleveurs. Les maladies détruisaient périodiquement les élevages et de ce fait 50% des oeufs étaient incubés pour renouveler les élevages. La source la plus importante de perte était due à la mortalité (61%) entre le moment de l'éclosion et du sevrage se produisant après 8 semaines. Ce système de production était caractérisé par l'absence ou la faible organisation de production et les faibles retours financiers. Les coûts les plus importants étaient de mettre en place l'élevage car après presque aucun investissement n'était établi pour développer l'élevage. Les sources de nourriture pour ces poulets étaient basées sur les restes de la maison, quelques apports en graines et toute nourriture comestible dans le voisinage de la maison.

Sistemas de producción de aves de corral en las aldeas de las tierras altas centrales de Etiopía

Resumen – Una estimación de la participación rural, sostenida por listas de comprobación y estudios intensivos de casos en casas unifamiliares se llevó a cabo en tres aldeas a tres altitudes diferentes en las tierras altas centrales de Etiopía. Se describen los sistemas de producción de aves de corral en cada aldea y se discuten los problemas. Más del 60% de las familias mantienen aves de corral y en la mayoría de los casos son las mujeres las que poseen y manejan las aves y controlan los beneficios de las ventas. Los sistemas de producción estudiados fueron principalmente de bajo beneficio y a pequeña escala, con 7 a 10 aves por casa, criadas en la parte de atrás con alojamientos, alimentación y cuidados sanitarios inadecuados. La producción media de huevos por nidada fue de 15 a 20, con 3 a 4 nidadas por año. La media de huevos por ave fue de $12,9 \pm 2,2$ ($n = 160$), dependiendo del tamaño del ave y de la estación, y la tasa de incubación fue de $80,9 \pm 11,1\%$, con un rango de 44 a 100% ($n = 160$). La carne y los huevos de aves de corral fueron en general aceptados y apreciados en las tres aldeas. Además de la baja cantidad de ingresos, los pollos camperos tienen funciones nutricionales, culturales y sociales. La composición del grupo, el precio de las aves y de los productos avícolas, la aparición de enfermedades y la incubación de los pollos se vieron fuertemente afectados por la estación. Se consideró la enfermedad como el problema principal para la mayoría de los miembros de la comunidad, seguida por los depredadores, la falta de alimento, la mala calidad del alojamiento, la falta de agua y los parásitos. Las enfermedades diezmaron periódicamente los grupos y, en consecuencia, un 50% de los huevos puestos fueron incubados con la intención de reponer las aves muertas. La mayor fuente de pérdida en el sistema era la elevada mortalidad de los pollos, (61%), que se dio entre la incubación y el fin del período de cría, a las ocho semanas de edad. El sistema se caracterizó por un coste bajo o inexistente y por un bajo rendimiento. El mayor coste fue la creación inicial del grupo, pero una vez establecido no se generó coste alguno. La mayor fuente de alimento para las aves fueron las sobras de la comida de las personas un poco de suplemento de grano y cualquier cosa comestible de los alrededores.