FURTHER ASSESSMENT OF SCAVENGING FEED RESOURCE BASE

E.B. SONAIYA, J.S. DAZOGBO, O.A. OLUKOSI
Department of Animal Science,
Obafemi Awolowo University,
Ile Ife, Nigeria

Abstract

FURTHER ASSESSMENT OF SCAVENGING FEED RESOURCE BASE.

The scavenging feed resource base (SFRB) was estimated in four villages located in a rainforest ecozone in Nigeria. The average SFRB estimated for the villages was 110 kg dry weight/family flock/year. Productivity of the birds in the villages was low. A low survivability of chicks was detected indicating a lot of wastage of eggs that could have been used for human consumption. The SFRB was low in nutritive value with less than 2 g crude protein (CP) available to each bird daily.

To more quantitatively describe the SFRB, the concept of using bird unit in determining what is available to each bird is suggested. This helped in evaluating at first glance the differential accessibility of each class of bird to the SFRB and assisted in strategic supplementation of the SFRB. The use of predictors of the SFRB could help in establishing prediction equation which would help in predicting the carrying capacity of the SFRB and in determining the optimum flock biomass more accurately.

1. INTRODUCTION

Family poultry has always served farming communities by gleaning the fields for grains dropped by the wayside during the processes of threshing, drying and transportation; and are known to make productive use of household leftovers. Experience in Vietnam shows the importance of scavenging ducklings in controlling insect pests and weeds, and in increasing the productivity of rice; while at the same time reducing the use of pesticides in rice field [1]. Gunaratne [2] described the simplest chicken production system, the traditional scavenging system, as the one in which feed is scavenged from the surrounding environment and household refuse with low levels of supplementation with by-products of local crops. This emphasizes the importance of the scavenging feed resource base (SFRB) as it gives the scavenging birds the opportunity of correcting any nutritional deficiency in the feeds offered as supplements [3].

The major components of the SFRB are household refuse, crop waste and the gleanings from gardens. Roberts [4] described a simple model for village chicken production in which the chicken population and the yield from it are determined by the capacity of the SFRB. In this model, the biomass of the village flock is maximized at the capacity of the SFRB. If the biomass exceeds the capacity of the SFRB, then there will be strong selection pressure against the weaker members of the flocks - the chicks and the growers. Consequently, there is need to determine, quantitatively and qualitatively, the SFRB available in different environments and at various seasons.

Gunaratne [5] described two methods of estimating the SFRB. The methods for determining the capacity of the SFRB have been applied to an egg production system in Sri lanka and to a meat production system in Indonesia. There is need to estimate the quantity and quality of the SFRB in different environments in Nigeria. This work was designed to estimate the quantity and quality of the SFRB available in six villages located in the rainforest ecozone of Nigeria.

2. MATERIALS AND METHODS

The SFRB was estimated by two approaches: by participatory rapid appraisal (PRA) with a questionnaire and by a case study for six weeks. A structured questionnaire was designed and pre-tested in two villages, after which it was revised and finally administered in six villages whose characteristics are shown in Table I.

Among the families rearing poulty in these villages, 12 families were randomly selected from four villages (Itamerin, Ile funfun, 'Agric' and Alakowe), and these were used as experimental units for the study which lasted six weeks.

For the evaluation of SFRB, the growth performance and egg weight per family flock were monitored for 6 weeks by weighing the birds and egg clutch weekly. During the second week, 18 birds were taken while scavenging, slaughtered, their crops removed and the crop content chemically analysed to determine its nutritive value. This procedure was repeated two weeks later. Thus, a total of 36 birds were used to determine the nutrient composition of the SFRB in the study areas.

The metabolizable energy (ME) of the crop content was determined using the equation:

$$ME\ (kcal/kg) = (4.1 \times starch) + (3.55 \times sugars) + (3.52 \times CP) + (7.85 \times EE) \times 10$$

where: CP = % crude protein; EE = % ether extract.

The SFRB was determined using the Roberts and Gunaratne (1992) formula:

$$SFRB = \frac{\sum Ej}{Es}$$

Where: j = average number of birds in family flocks; Ej = ME requirement for daily maintenance and production of each bird/day (kcal/kg dry weight); Es = ME in the scavenged feed (Kcal/kg dry weight).

The calculation of Ej was made for each bird from the production data of growth rate and egg production using the NRC [6] formula:

$$ME/\ bird\ daily = W^{0.75}(173\text{-}1.95T) + 5.5\Delta W + 2.07EE$$

Where: W = body weight (kg); T = ambient temperature (°C); ΔW = change in body weight (g/day); EE = daily egg mass (g).

Linear correlation analysis was used to evaluate the relationship between SFRB and biomass in the different villages. Analysis of variance was used to test for differences in the quantity of the SFRB available in the study villages. Significance was determined at $P \leq 0.05$.

3. RESULTS

A majority (66%) of the households kept family poultry (Table I). Average flock size was 15 ± 8.1 bird/family. A majority of the respondents (98%) managed their flocks on a free-range system. An equally high percentage (78%) gave feed supplement to their birds. Respondents reported that their chickens scavenged the environments for feedstuffs such as insects, leaves, kitchen residue, household refuse, stone grits, maggots, palm oil sludge, fruits, cassava peels and *gari*[1] sievings amongst others.

TABLE I. GENERAL CHARACTERISTICS OF THE STUDY VILLAGES IN SOUTH-WESTERN NIGERIA

Villages	No. of households responding (RHH)	Proportion of RHH with poultry (%)	Total number of birds	Average flock size*
Opa	6	100	39	6.50 ± 3.94
'Agric'	11	73	171	21.38 ± 17.28
Alakowe	19	42	146	18.34 ± 8.86
Alaro	14	57	104	7.38 ± 5.90
Ile funfun	8	63	82	10.21 ± 5.92
Itamerin	13	62	380	26.14 ± 31.61
Total	71		922	

*Average flock sizes are based on those families that keep chicken, not on all families in the village community. Description of the villages: Itamerin is a small settlement of 12 households located on a road linking two urban towns. It has a primary school. Residents are predominantly farmers with women processing cassava into 'gari' and 'fufu'; and palm fruits into palm oil. Mango trees are common, hence possible feed resources include fallen ripe mangoes, palm oil sludge, cassava peels and sieving. Alakowe is located on the same road. Most residents are farmers with the same crop as Itamerin, but Alakowe is about 3 times larger with signs of greater non-farm commercial activities like trading and crafts. Agric village is so called being located within the University's Teaching and Research Farm, farming and trading are the main occupations here. Farming activities are common in Ile funfun with residential buildings interspersed among farmlands. Opa and Alaro villages share the same characteristics with the rest of the villages.

On average, a hen had 3 clutches in a year with an average of 10 eggs per clutch (Table II). Thus, a hen produced about 30 eggs in a year out of which it hatched 24. Percentage hatchability was 83%, and survivability was about 53%. Consequently, just about 14 eggs of the 30 laid per hen yearly actually became available to replenish the family flock. Since the average body weight of a mature chicken in the study villages was 987 g, a hen could produce about 13 kg of poultry meat in a year.

[1] *Gaari* is the processed (grated, fermented and fried) cassava product that is a staple food in Nigeria.

TABLE II. PRODUCTIVITY OF SCAVENGING VILLAGE CHICKENS IN SOUTH-WESTERN NIGERIA

Parameters	Range	Weighted mean	Standard deviation
Flock Size	3–30	12.01	6.44
Number of clutches/year	2–4	2.95	0.55
Number of eggs/clutch	7–12	9.28	2.97
Hatchability (%)	60–100	48.43	33.64
Age of birds at marketing (months)	6–12	8.32	3.79
Number of birds culled/year for home use	1–7	5.8	1.60

The total biomass of scavenging chickens in the study villages showed that 'Agric' village had the highest biomass (36057 g) followed by Alakowe (24665 g), while Ile funfun had the lowest (10045 g) (Table III).

TABLE IV. THE QUANTITY AND NUTRITIVE VALUE OF SFRB IN FOUR OF THE STUDY VILLAGES

Village	Flock biomass (g)	SFRB		
		DM, g/family/day	ME, kcal/kg	g, CP
Itamerin	24 665	458	2.74	32.5
Alakowe	13 546	156	0.81	15.0
Ile funfun	10 045	273	0.81	11.0
'Agric'	36 057	353	2.79	26.0
Average	21 078	310	179	21.13

DM = dry matter; ME = metabolizable energy; CP = crude protein.

Itamerin had the highest quantity of the SFRB (458 g dry weight/family/day), while Alakowe had the lowest, (156 g dry weight/family/day). There is a high correlation (r = 0.93) between the village flock biomass and the SFRB (Table IV). This indicates a strong relationship between the SFRB and the biomass which it can support. On the basis of 6.87% CP of the SFRB, the g CP obtainable from scavenging was estimated in each village. Itamerin had the highest, 32.5 g CP was available to each family flock daily, while in Ile funfun, only 11.0 g CP was available to a family flock daily. A high correlation (r = 0.78) was found between the g CP obtainable from scavenging and the total biomass in the villages. There was no significant ($P > 0.05$) difference across the study villages in the dry weight of the SFRB and in the g CP or the ME (kcal/kg) of the SFRB. There was, however, a significant ($P \leq 0.05$) difference in the total biomass of family flock among the villages.

4. DISCUSSION

The result of the PRA showed that the majority of households in village communities kept poultry as an additional occupation along with farming and other non-agricultural activities. This is in agreement with previous reports [7, 8]. The implication of this on the development strategy of family poultry is that innovations must take into account the secondary nature of the family poultry enterprise in the communities. Thus, strategies to improve production should not be too demanding in time and inputs.

The productivity of the village chicken was similar to that indicated by Smith [9], who reported that scavenging chickens produced 20–30 eggs per annum. Although the birds had high hatchability, survivability of the chicks was very low. This indicated a lot of wastage of eggs that could have been used for human consumption, and a loss of the SFRB which could have been used for feeding the surviving chicken. The low survivability could have been due to poor management practices. About 35% of the respondents indicated that they provided no housing for their birds, 28% provided no medication, and only about 24% provided supplement once a day.

The average SFRB estimated for all the villages was 307 g dry weight/day, i.e. 110 kg dry weight/family flock/year. Studies by Gunaratne *et al.* [5] reported 197 kg/year, Javiriyasopak *et al.* [10] reported 390 kg/year, while Kingston and Creswell [11] reported 475 kg/year. Apparently a wide

TABLE III. AVERAGE BODY WEIGHT AND TOTAL BIOMASS OF VILLAGE FAMILY FLOCKS IN SOUTH WESTERN NIGERIA

Village	Chicks		Growers		Hens		Cocks		Total biomass		Egg		
	No.*	Av. Wt.	No.	Av. Wt.	No.	Av. Wt.	No.	Av. Wt.	No.	Av. Wt.	No.	Av. Wt.	Mass
Itamerin	N.A.	N.A.	N.A.	417 ± 238.6	9	864 ± 116.9	2	929 ± 92.6	47	24 665	43	36 ± 4.5	1547
Alakowe	N.A.	N.A.	226	510 ± 216.1	4	1042 ± 85.1	N.A.	N.A.	22	13 546	N.A.	N.A.	N.A.
Ile funfun	7	28.3	N.A.	410 ± 192.5	4	846 ± 159.3	2	1074 ± 33.9	24	10 045	7	32 ± 2.2	226
'Agric.'	36	80.6 ± 73.4	1773	489 ± 229.4	16	820 ± 142.5	3	1088 ± 28.4	89	36 057	N.A.	N.A.	N.A.
Total	43	-	99	-	33	-	7	-	182	84 313	50		1773

N.A. - not available at the time of study; Av. Wt. = average weight; No. = number of birds in the village, not in a family flock.

variation in the SFRB was available to birds in different environments. The estimated SFRB in the study villages was the lowest in comparison with other studies. The study was carried out at a period between early harvest and late harvest when there was less SFRB around, and the value could have been higher if estimated at another season. This emphasizes the need to completely evaluate the SFRB in different environments.

The nutrient quality of the SFRB in the villages was relatively poor. On average, 21 g CP was available each day to a family flock in each village. As the average flock size in the villages was 12 birds, less than 2 g CP was available to each bird/day. This appears to be too low for the needs of the birds for maintenance and production, which contrasts with a commercial chicken which derives about 11 g of CP from its feed daily. It can be concluded that improving the nutritional status of the birds could improve their productivity. Generally, studies have shown that the nutritional status of scavenging chickens is poor. Huque [12] found that scavenged feed was very low in phosphorus, although calcium content was close to the requirement, creating an unfavourable Ca/P ratio. However, the same study revealed that the CP was high in some environments due to the availability of insects to scavenging birds. The CP in the SFRB estimated for the villages in our study was low.

The SFRB can be defined as all the materials which are always, or seasonally, available in the environment and which the scavenging birds can use as feed. From observations and responses of the villagers, the SFRB consisted of materials coming from the environment which included insects, leaves, fruits, etc. Other materials that made up the SFRB came from the household including kitchen leftovers and other crop processing by-products. Samnang [3] indicated that there were economic advantages if around the homestead were fruit trees, a biodigester and duckweed ponds as this ecosystem supports the growth of feed resources that local chicken can extract, thus reducing their need for supplements.

SFRB has been used to determine the carrying capacity of the feed resources in an area. It provides a basis for determining when the total biomass of scavenging poultry is exceeding its optimum level supported by the available feed resources. The procedure suggested by Roberts and Gunaratne (1993) helps in determining the SFRB on the basis of what each family flock has access to in a unit of time (per day or per year). However, this quantity of the SFRB does not show at first glance what proportion of the SFRB is available to each bird in the family flock. Obviously, the proportion of the SFRB available to each bird is not given by simply dividing the available SFRB by the average family flock size, since the access of a chick to the SFRB is not equal to that of a cock.

Our study showed that the majority of the villagers (56%) were not keeping kitchen waste in the bin. This indicated a communal disposal of household leftovers. This, in fact, was usually the case in many villages of Southwestern Nigeria. Since the birds moved about, they were able to derive the benefit of feeding on the household leftover of families that were not keeping poultry. In many village communities, other livestock and domestic animals apart from poultry were kept. These also scavenged the SFRB and competed with family poultry.

It appeared that estimation of the SFRB on the basis of what was available to each class of scavenging chickens (cocks, hens, growers and chicks) would be more suitable to show the differential access that each of the birds in the family flock had to the SFRB. When there is a communal disposal of the household leftovers as is usually the case in village communities, birds of all ages and sizes compete for the leftovers and there is an edge that body weight of each bird has on its access to the leftovers. It might be useful to use bird unit in computing the SFRB instead of absolute number of birds in a flock. If the body weight of 1 bird unit is known, the quantity of the SFRB available to a bird of known body weight can be estimated, and the quantity of the SFRB which is available to a family flock of known bird unit could be determined. This will require the determination of flock biomass (Tables III and IV).

The following equation is suggested for estimating the SFRB on the basis of the flock bird unit:

$$\text{SFRB} = \frac{H}{P} \times \frac{1}{B}$$

Where:
H = quantity of household leftover (g dry weight/family/day);
P = proportion of crop content which is household leftover;
B = average family flock bird unit;

Bird unit (B) is defined as a unit assigned to birds of known body weight such that body weight differences are eliminated. For example, if a bird weighing 1000 g is assigned 1 bird unit, a bird

weighing 750 g will be assigned 0.75 bird unit. This implies that 4 birds weighing 750 g each will be equal to 3 bird units. As a result, a flock containing 5 birds, and having the flock composition described above has 4 bird units of the same body weight.

In our study, 1 bird unit weighed 1039 g, being the highest body size in the study, the average body weight of cocks. All other classes of chickens (hens, growers and chicks) had average body weights lower than the cocks (Table V).

TABLE V. ASSIGNMENT OF BIRD UNITS RELATIVE TO THE COCK

Class of Bird	Average body weight (g)	Bird unit assigned
Cocks	1039	1
Hens	873	0.8
Growers	458	0.4
Chicks	72	0.07

From Table III, the average number of birds in each village was 1.75 cocks, 8.25 hens, 24.75 growers, and 10.75 chicks. Thus, the average total bird unit per village can be calculated (Table VI).

In our study, the following values for H and P were obtained:
H - 273 g dry weight/family/day; P - 0.38; B - 19

The SFRB on the basis of bird unit can be calculated as:

$$\text{SFRB} = \frac{H}{P} \text{ X } \frac{1}{B}$$

$$\text{SFRB} = \frac{273}{0.38} \text{ X } \frac{1}{19} = 13.80 \text{ kg dry weight/bird unit/year}$$

TABLE VI. CALCULATION OF AVERAGE TOTAL BIRD UNIT PER VILLAGE

Classes of birds in each village	Average number/flock	Multiplier*	Total bird units
Cocks	1.75	1	1.75
Hens	8.25	0.8	6.6
Growers	24.75	0.4	9.9
Chicks	10.75	0.07	0.75
Total	-	-	19

* being the bird unit

If the flock composition and body weight is known, it is possible to compute the SFRB which is available to a family flock. The use of the equation requires assignment of bird unit values for each class of bird. Given the communal disposal of SFRB detected in the study villages, a cock and a chick would not have equal access to SFRB. The proposed equation on the basis of bird unit helps determine the quantity of the SFRB that could be available to each bird on the basis of its body weight. For example, the estimated quantity of SFRB available to a chick in the study villages is 0.966 kg/year, whereas a hen would have 11.04 kg/year. The advantage of this system of estimating the SFRB is that it shows at a quick glance, the difference in the quantity of the SFRB available to birds of different ages (assuming age is used to determine classes of birds, e.g. chicks or growers; and different classes having different body weight). The quantity of the SFRB available to chicks in the study villages was very low (0.966 kg/year) and strategic supplementation of the SFRB on the basis of age and production status is indicated. Indeed, such poor nutritional status could be implicated as a cause for the high chick mortality recorded in our study.

More work is required in estimating the SFRB in different environments and seasons. The assignment of bird unit to various classes of family flock (chicks, growers, hens, and cocks) can be done under field conditions without weighing the birds.

Additional experiments are needed to look at the relationship between the quantity of the SFRB in a community and the body weight of the more vulnerable members of the flock (chicks and growers). There are reports of severe mortality of chicks in different communities [8, 13]. This high level of mortality has been linked to diseases, but the root cause could really be poor nutrition which predisposes birds to diseases and makes the birds more vulnerable to predation.

There is need to completely enumerate all the indicators or predictors of the carrying capacity of the SFRB. This goes beyond estimating the H, P , S, or B as used in the existing equations for estimating the SFRB. Such predictors could include grass cover (since scavenging chickens graze to some extent), the stage of agricultural activity (planting, weeding and harvesting), the socio-economic index of an average family (determines the quantity of household leftover available to scavenging chickens), number of refuse heaps (these are favoured scavenging areas for birds), distance of farms to households (this determines the access of birds to gleanings from the fields), determination of quantity of other metazoa and insects as was done in the study of Men *et al*. [1]. Eventually it might be possible to establish an equation that would help in predicting the carrying capacity of the SFRB and in determining more accurately the optimum flock biomass.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the support of the National Agricultural Programme (NAP) for funding the research work. The assistance and cooperation of the village farmers whose flocks were used in the study are gratefully acknowledged and so are the students who helped in the study.

REFERENCES

[1] MEN, B.X., TINH, T.K., PRESTON, T.R., OGLE, R.B., LINDBERG, J.E., Use of local ducklings to control insect pests and weeds in the growring rice field, http:\\www.cipav.org.co/lrrd/lrrd11/2/men112.htm (1999).

[2] GUNARATNE, S.P., The family and its poultry: averting nutritional deficiency and competition. Proc. of XXI World's Poultry Congress, Aug. 20-25, 2000, Montreal, Canada (in press).

[3] SAMANG, H., Pasture versus integrated farming system as scavenging sources for local and exotic chicken, http:\\www.cipav.org.co/lrrd/lrrd10/3/sam103p.htm (1998).

[4] ROBERTS, J.A., Assessing the scavenging feed resource base for sustainable smallholder poultry development. In: Sonaiya, E.B. (Ed.) Sustainable rural poultry production. Proc. NRPD, June 13-16, Addis Ababa, Ethiopia (1997) 40-52.

[5] GUNARATNE, S.P., CHANDRASIRI, A.D.N., HEMALATHA, W.A.P.M., ROBERTS, J.A., The feed resource base for scavenging village chickens in Sri Lanka, Trop. Anim. Hlth Prod. **26** (1993) 249-257.

[6] NATIONAL RESEARCH COUNCIL, Nutrient requirement of poultry. Subcommittee on poultry nutrition, National Academy Press, Washington D.C. (1994).

[7] SONAIYA, E.B., LAOGUN, E.A., MATANMI, O., DANIYAN, O.C., AKANDE, B.E., OGUNTADE, E.A., OMOSEIBI, R.O., OLORI, V.E., Health and husbandry aspects of village extensive poultry production in South Western Nigeria. In: Pandey, V.S, Demey, F. (Eds) Village poultry production in Africa. Proc. May 7-11, 1992, Rabat, Morocco (1993) 34-41.

[8] CHILIGATE, J.E., FOSTER, H.A., CHITUKURO, H.R., A study of the current management practices and production parameters of small poultry enterprises of the Wagogo people of central Tanzania. In: Sonaiya, E.B. (Ed.) Sustainable rural poultry production. Proc. ANRPD, June 13-16, Addis Ababa, Ethiopia (1997) 34-41.

[9] SMITH, J., The integration of rural poultry production into the family supply system. In: Smallholder Rural Poultry Production. CTA Seminar, Proc. Oct. 9-13, 1990, Thessaloniki, Greece, Vol. I (1990) 115-128.

[10] JANVIRIYASOPAK, D., THETISAK, W., THEPKRAIWAN, L., JANGSATHEIN, K., MEKAPRATHEEP, M., KRUEDNER, R. VON, MORRIS, R.S., A health and productivity study of village poultry. Proc. Int. seminar on animal health and production services for village livestock, Khon Kaen, Thailand (1989) 161-171.

[11] KINGSTON, D.J., CRESWELL, D.C., Indigenous chickens in Indonesia: population and production characteristics in five villages in West Java, Research institute for animal production, Bogor, Indonesia, Report No. 2 (1982) 3-8.
[12] HUQUE, Q.M.E., Nutritional status of family poultry in Bangladesh, http:\\www.cipav.org.co/lrrd/lrrd11/3/huq113.htm (1998).
[13] MAHAKA, S., Existing rural poultry production systems in Tanzania. In: Sonaiya, E.B. (Ed.) Rural poultry in Africa. Proc. ANRPD, Nov. 13-16, 1989, Ile Ife, Nigeria (1990) 177-181.
[14] ROBERTS, J.A., GUNARATNE, S.P., The scavenging feed resource base for village chickens in a developing country, Proc. XIX World's Poultry Congress, Amsterdam, 19-24, September (1992) 822-825.