

## Characteristics of Indigenous Chicken Production System in South West and South Part of Ethiopia

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**Abstract:** The study was conducted with the aim of assessing characteristics of indigenous chicken production system of two districts (namely, Dawo and Seden Sodo in South West Showa Zone) of South West part of Ethiopia and two districts (namely, Mehale Ameba and Mehurena Aklile in Gurage Zone) of South part of Ethiopia. The study covered 300 households. A survey with structured questionnaires were used to collect all the relevant data, using a multi-stage sampling method in order to design future improvement and conservation strategies. The results of the study showed that the dominant (71.55 %) chicken production system of the study area was a traditional or extensive chicken management system. The mean chicken flock size per household of the study area was 6.36 chickens. Almost all farmers (96.3 %) in the study area provided supplementary feeding to their chickens and chickens of different age groups were fed together. About 77.9% of village chicken owners kept birds on various night sheltering places either in part of the kitchen (0.3 %) or in the main house (4.7 %), perches inside the house (90.9%) in bamboo cages (3.7 %) or in separate sheds purpose-made for chickens (0.3 %). The major causes of death of chickens during the study were seasonal outbreaks of Newcastle disease (locally known as fengele) and predation. Focus should be given on indigenous poultry production system and utilization system to effectively utilize the resource. Therefore It is important to collect and conserve local poultry breeds before they are fully replaced by the so-called improved breeds.

**Key words:** Ethiopia • Feeding • Indigenous Chicken • Production System

### INTRODUCTION

Poultry is the largest livestock species worldwide [1], accounting for more than 30% of all animal protein consumption [2]. Chickens largely dominate flock composition and make up about 98 % of the total poultry (chickens, ducks and turkeys) population kept in Africa [3]. Small scale and semi-commercial poultry production is seen as a vital tool in reducing poverty and hunger in developing countries. Poultry keeping is making an important contribution to the livelihoods of the most vulnerable rural households in developing countries. During the last decade, the consumption of poultry products in developing countries has grown by 5.8 percent per year [1].

Poultry production is categorized into traditional scavenging, small and large-scale market orientated sectors, which is based on the objective of the producer, the type of inputs used and the number and types of chickens kept [4, 5]. The rural poultry sector constitutes about 98 % of the total chicken population [6] and are largely consists of the indigenous or native domestic fowl. The traditional back yard systems are characterized by mainly low-input and small-scale, with 4-10 mature birds per household, reared in the back yards with inadequate housing, feeding and health care. Scavenging is the most important component of the poultry diet and they are usually capable of finding feeds for their maintenance requirement plus the production of few eggs [7].

Rural poultry production contributes over 98% of national egg and over 99% of poultry meat production [8]. Indigenous chickens are preferred to exotic chickens because of their pigmentation, taste, flavor and leanness. Systematic characterization, breed improvement and conservation programs may help to sustain village chicken production system in Ethiopia and could be a useful micro-economic strategy in the on-going poverty alleviation process in the country. This study was, therefore initiated to characterize indigenous chicken production system in South West Showa Zone and Gurage Zone of Ethiopia.

### MATERIALS AND METHODS

The study area which include Dawo and Seden Sodo districts from South West Showa Zone of South West part and Mehale Ameba and Mehurena aklile districts from Gurage Zone of South Nations and Nationalities people (Ethiopia) were selected based on purposive multi Stage sampling method. A rapid field survey was done before the main survey, to map out the distribution and concentration of local chicken ecotypes. Based on the information gathered through the rapid field survey and in consultations with district agriculture expert, two districts from each zone and three Peasants Associations (PAs) from each district were selected. During selection, extension agents and farmers were communicated and that area with good road accessibility and no or little intervention of exotic breed were selected. Within each districts considering earlier poultry technology interventions, appropriate peasant associations were selected and within Peasant association (PAs), 25 households totally 300 households were selected using random sampling technique using the formula given by Arsham [9].

$$N=0.25/ SE^2,$$

Where,

N= Sample size,

SE= Standard error

**Data Analysis:** Descriptive statistics was used to analyze the data captured and compared as percentages using Statistical package for Social Science [10].

### RESULTS AND DISCUSSION

#### Household Characteristics and Respondents Profile:

The household characteristics of the respondents are presented in Table 1. From the total interviewed local chicken owners, 94.7, 72.2, 64 and 85.1 % were female in Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile districts, respectively. The higher proportion of female respondents (79.1%) than males (20.9%) revealed the fact that female were managing the village poultry rearing in all districts. This was in agreement with the results reported by Muchadeyi *et al.* [11] and Khandait *et al.* [12]. Gueye [13] found that approximately 80 % of the chicken flocks in a number of African countries were owned and largely controlled by women.

The average age of respondents was 40.9 years both for Dawo and Seden Sodo while for Mehale Ameba and Mehurena Aklile was 36.3 and 42.6 years respectively. Education level of respondents showed that about 17.3, 61.1, 50.7 and 37.8 % were illiterate in Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile districts, respectively while 5.3, 5.6, 12 and 14.9% of respondents have basic education (reading and writing) in the above four districts, respectively.

Table 1: Household characteristic of respondents in the study districts

House hold characteristics	Study districts				Over all mean
	Dawo N=75	Seden Sodo N=72	Mehale Ameba N=75	Mehurena Aklile N=74	
Sex of respondents (%)					
Female	94.7	72.2	64	85.1	79.1
Male	5.30	27.8	36	14.9	20.9
Average age of respondents (yrs)	40.9	40.9	36.3	42.6	40.2
Educational level (%)					
Illiterate	17.3	61.1	50.7	37.8	41.6
Read and write	5.30	5.60	12.0	14.9	9.50
Primary school	66.3	33.3	30.7	44.6	42.6
Secondary school	11.1	0.0	6.7	2.7	6.40
Average land holdings (ha)	2.17	1.73	0.89	1.11	1.47
Average family size(no)	7	6.79	5.84	5.97	6.40

Table 2: Average chicken flock composition and size in four districts

Type of chicken	Study districts				Over all mean
	Dawo N=75	Seden Sodo N=72	Mehale Ameba N=75	Mehurena Aklile N=74	
Chicks	1.09±3.21a (20.15)	0.61±1.94a (14.84)	0.99±2.65a (19.30)	1.04±1.78a (21.89)	0.93±2.46 (19.18)
Cockerels	0.05±0.32a (0.92)	0.26±0.9ab (6.33)	0.48±1.36b (9.36)	0.41±1.0b (8.63)	0.30±0.98 (6.19)
Pullet	0.33±1.25a (6.10)	0.60±1.10a (14.60)	0.55±1.07a (10.72)	0.52±0.93a (10.94)	0.50±1.09 (10.31)
Hens	3.39±2.12a (62.66)	2.11±1.38be (51.34)	2.71±1.68c (52.82)	1.99±1.48de (41.90)	2.55±1.77 (52.57)
Cock	0.55±0.78a (10.17)	0.53±0.58ab (12.90)	0.4±0.84ac (7.80)	0.79±0.76d (16.64)	0.79±0.76d (11.75)
Total chicken no/HH	5.41 (100)	4.11 (100)	5.13 (100)	4.75 (100)	4.85 (100)

Values given in parenthesis are in percent

*abcde* = Means in the same row with different superscript letters differ significantly ( $\alpha=0.05$ )

On an average 42.6% of the respondents in the study districts have gone through primary school and about 6.4% of the respondents completed secondary school and above.

The average land holding per household and the overall mean family size of sample households in Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile districts were 2.17, 1.73, 0.89 and 1.11 hectares, respectively with an overall mean of 1.47 hectares. The highest average land holding/house hold (2.17 ha) was recorded in the districts of South West Showa Zone and the lowest average land holding/ household (1 ha) was recorded in the districts of Gurage Zone. The difference in land holdings in two zones could be attributed to the difference in availability of small arable land and relatively high population pressure in Gureze zone. The corresponding average family size in four districts was 7.0, 6.79, 5.84 and 5.97 persons, respectively with an overall mean family size of 6.4 persons. The overall mean family size (6.4) in the study area was higher than the national average of 5.2 persons [14] However, this is similar to the findings of Mapiye and Sibanda [21] who reported 6.2 and 6.9 persons per household for Bure and Dale districts of North West and Southern Nations Nationalities and peoples Regional State respectively.

**Mean Flock Size and Composition:** The average chicken flock size per household and flock structure in the studied households is presented in Table 2. Out of the total flocks, hens account for 62.66, 51.34, 52.82 and 41.90% for Dawo, Seden Sodo, Mehale Ameba and

Mehurena Aklile, respectively. Similarly out of the total flocks counted, young chicks accounted for 20.15, 14.84, 19.30 and 21.89% for Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile, respectively. The corresponding proportions of cocks was 10.17, 12.90, 7.80 and 16.64% in the respective districts. The proportions of cockerels and pullets varied from 0.92 to 9.36% and 6.1 to 14.6% respectively.

The total chicken holding per household 5.41, 4.11, 5.13 and 4.75 for Dawo, Seden Sodo, Mehale Amba and Mehurena Aklile, respectively is in line with the report by Gueye [15], who reported that the flock sizes generally ranged from 5 to 20 fowls per African village household. An overall average flock size per household for chicks and cocks and for hens/pullets was 4.73 and 2.40, respectively, with a total flock size of 7.13 was also reported in North west Ethiopia [16]. An average flock size 6.23 birds per house hold was also reported in Gomma Woreda of Jimma Zone [17]. However, a relatively higher flock size of 18.8 birds /household, was reported by Khalafalla, *et al.*, [18] in Sudan. Similarly, 16 birds/ household were reported in the central highlands of Ethiopia and South coast Kenya by Tadelles *et al.* [19] and Njenga [20] respectively.

Ownership of relatively higher proportion of hens and young chicks in all the study districts indicates that this is purposely done by farmers to ensure production of replacement flock in a sustainable manner (about 64% of the replacement is from own stock) and also to produce adequate number of eggs for sale and household consumption.

Table 3: Various chicken husbandry practices in four districts

Parameters	Study districts				Over all mean
	Dawo N=75	Seden Sodo N=72	Mehale Ameba N=75	Mehurena Aklile N= 74	
Chicken management system (%)					
Extensive	97.3	69.4	58.4	60.8	71.6
Semi-intensive	2.7	30.6	41.3	39.2	28.5
Supplementary feeding (%)					
Yes	100.0	95.8	94.7	94.6	96.3
No	0.0	4.2	5.3	5.4	3.7
Watering system (%)					
Yes	100.0	100.0	98.7	100.0	99.7
No	0.0	0.0	1.3	0.0	0.3
Housing system (%)					
In kitchen	1.3	0.0	0.0	0.0	0.3
In main house	6.7	11.1	0.0	1.4	4.8
On perch	78.7	88.9	98.7	97.3	90.9
Bamboo cage	13.3	0.0	0.0	1.4	3.7
Poultry house	0.0	0.0	1.3	0.0	0.3

Table 4: Culling practices of chicken in four districts

Parameters	Study Disrticts				Over all mean
	Dawo N=75	Seden Sodo N=72	Mehale Ameba N=75	Mehurena Aklile N=74	
Purpose for culling (%)					
Consumption	16.0	0.0	16.0	4.1	9.1
Sale	66.7	90.3	61.3	71.6	72.3
Scarifies	0.0	1.4	0.0	5.4	1.7
Consumption & sale	17.3	8.3	22.7	18.9	16.9
Reasons for culling (%)					
Poor productivity	37.3	44.4	18.7	27.0	31.8
Old age	36.0	20.8	21.3	28.4	26.7
Before rainy season	2.7	4.2	24.0	23.0	13.5
Disease	9.3	29.2	32.0	8.1	19.6
Large no of chicken	14.7	1.4	4.0	13.5	8.4

**Production Systems:** The various chicken husbandry practices followed in four districts under study is presented in Table 3. The extensive and semi-intensive chicken production systems were being practiced in the study districts. About 71.6 % the chickens are managed under a traditional or extensive chicken management system while 28.4% respondents were using semi-intensive management system. Extensive production system was being used by 97.3, 69.4, 58.7 and 60.8% of respondents in Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile districts, respectively against 2.7, 30.6, 41.3 and 39.2% of respondents using semi-intensive system in the study area.

**Feeding and Watering Practices:** Almost all (96.3 %) farmers in the study area (Table 3) provided supplementary feeding to their chickens and chickens of different age groups were fed together. This finding is in

line with the work done by Mapiye and Sibanda [21], who reported 96.8 % of the farmers in Zimbabwe, supplied partial supplementation of feeds and 95.5 % of the feed was produced locally. However Halima *et al.* [5] reported 99.28 % of the farmers in Northwest Ethiopia provided supplementary feeding to their chickens. Moges *et al.* [22] also reported that About 98, 93 and 98% of respondents in Bure, Fogera and Dale, respectively, offer supplementary feeds to their chicken. The survey results also indicated that almost all the respondents (99.7%) in the study areas provided water *ad libitum* to their chicken.

**Poultry Housing System:** From Table 3 it is revealed that all (100%) respondents kept their birds on various night sheltering places with majority of them using perches inside the house (90.9%), followed by main house (4.8 %), bamboo cages (3.7 %), part of the kitchen (0.3 %) or

separate sheds made for chickens (0.3). These shelters were made of locally available materials such as tree and bamboo. This is an indication that the owners are aware of the importance of housing. This finding is similar with what was reported in North West part of Ethiopia [16], Moges *et al.*[23]. And also in Botswana 35.8 % of the indigenous chicken farmers provided housing of some kind [24].

**Culling Practice:** Culling and depopulation practices (Table 4) revealed that majority of the respondents dispose their birds in the study districts through sale for income (72.3%) followed by both for consumption and sale (16.9%), home consumption (9.1%) and religious sacrifices (1.7%). Similar trends were reported in other African countries. For example, in the western middle-belt region of Nigeria, Atteh [25] reported that village fowls were kept for income (11 %), consumption (28 %), income and consumption (45 %), ceremonies (3 %), income and ceremonies (11 %), consumption and ceremonies (3 %). In the Keita region of Niger, 47 %, 38 % and 16 % of the chickens reared were used for home consumption, trade and gifts, respectively [26].

A study done in the central part of Ethiopia has also shown that 26.6 % of the birds were reared to be sold, while 25 % were used for sacrifice or healing, 20.3 % for replacement and 19.5 % for home consumption [27]. Similarly in Northwest part of Ethiopia Chickens were mainly culled for home consumption and sale (53.3); 19.22 % of the chickens were sold because of fear of disease and 21.81 % were sold solely to generate income [16].

The sale of chicken as a source of income was main criterion of chicken disposal in all the four districts under study. The reasons of disposal as cited by farmers' were poor productivity (31.8%), old age(26.7%), rainy season (13,55), diseases(19.6%) and lack of capacity to manage large number of birds (8.4%) as major determining factors in culling and reducing the number of chickens (Table 4).

**Source of Chick Replacement and Finance:** Most of the respondent (91.9%) obtained the initial chicken stock by purchasing and the rest was by hatching (4.4%) and gift (3.7%) from parents or relatives. The source of replacement stocks (Table 5) were also observed as hatching (63.9 %), purchase (31.1 %) and gift (5.1 %) in all districts under study. The main source of capital to start chicken production and replacement stock was the sale of crops (46.36 %) followed by sale of eggs (20.5%), off farm income (16.5%), sale of poultry birds (6.65%), other animal sale ( 5.55%) and cash crops (4.43%).

**Diseases and Treatment:** The prevalence of chicken diseases in Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile districts was 100, 95.8, 100 and 97.6% respectively, with an overall mean of 97.6% (Table 6). Major disease was Newcastle disease as reported by 100, 95.8, 94.7 and 67.6 % in the above four districts respectively, with an overall mean of 89.5% respondents in the study area. Similarly 97.5, 100 and 62.9% of the respondents in Bure, Fogera and Dale districts, respectively, confirmed that occasional and serious disease outbreak results in complete devastation of

Table 5: Source of replacement stock and finance for village chicken production in four districts

Parameters	Study Disricts				Over all mean
	Dawo N=75	Seden Sodo N=72	Mehale Ameba N=75	Mehurena Aklile N=74	
Source of initial stock (%)					
Purchased	96.0	97.2	90.7	83.8	91.9
Hatched	2.7	2.8	1.3	10.8	4.4
Inherited	1.3	0.0	8.0	5.4	3.7
Source of replacement stock (%)					
Hatched	41.3	90.3	69.3	55.4	63.9
Purchased	58.7	6.9	18.7	39.2	31.1
Inherited / gift	0.0	2.8	12.0	5.4	5.1
Source of finance (%)					
Sale of poultry	2.7	5.6	13.3	5.0	6.65
Sale of eggs	10.0	18.0	28.0	26.0	20.50
Other animals sale	15.3	2.8	2.7	1.4	5.55
Sale of crops	70.7	61.1	21.3	32.4	46.40
Sale of cash crops	0.0	2.8	0.0	14.9	4.43
Of farm income	1.3	9.7	34.7	20.3	16.50

Table 6: Prevalence of chicken diseases and treatment

Parameters	Study Distriets				Over all mean
	Dawo N=75	Seden Sodo N=72	Mehale Ameba N=75	Mehurena Aklile N=74	
Prevalence of disease (%)					
Yes	100.0	95.8	94.7	100.0	97.6
No	0.0	4.2	5.3	0.0	2.4
Main diseases (%)					
Newcastle	100.0	95.8	94.7	67.6	89.5
Cough	0.0	0.0	0.0	25.7	6.4
None	0.0	0.0	0.0	6.8	1.7
Inherited / gift	0.0	4.2	5.3	0.0	2.4
Treatment (%)					
Traditional	92.0	63.9	77.3	58.1	73.0
No treatment	8.0	36.1	22.7	9.5	18.9
Consult vet	0.0	0.0	0.0	32.4	8.1

the flock when accrued [22]. Halima [5] also reported that the major cause of death in local chicken in Northwest Amhara is seasonal outbreak of diseases, specifically Newcastle Disease.

Sick birds are sold immediately or slaughtered for home consumption. There is no practices of isolating sick birds from the household flocks and dead birds could sometimes be offered or left for either domestic or wild predators. The results of this study is in agreement with that of Solomon [28] who reported that the bio-security of the backyard poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock.

Prevalence of exoparasite and coughing was reported by 6.4% and 1.7% respondents while 2.4% of the farmers reported no disease problem in their chicken. Traditional (ethno-veterinary) treatment is used by the majority of chicken owners (Table 6) as indicated by 92.0, 63.9, 77.3 and 58.1% respondents in Dawo, Seden Sodo, Mehale Ameba and Mehurena Aklile districts, respectively against NCD and other killer diseases. About 18.9% of the farmers do not give any treatment to their chicken while 8.1% of the farmers consult veterinarians for the control of chicken diseases in the study area.

### CONCLUSION

Indigenous chicken production requires less space and investment and can therefore play an important role in improving the livelihood of the poor village family. Therefore focus should be given on indigenous poultry production system and utilization system to effectively

utilize the resource. Training for farmers and extension staffs focusing on diseases control, improved housing feeding, proper data recording system should be arranged to be successful in chicken production under village production system and attention may be given to collect, conserve and genetically improve local chicken in the study area.

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### REFERENCES

1. FAO, 2000a. FAOSTAT. Statistical database of Food and Agriculture Organisation of the United Nations, Rome., Italy.
2. Permin, A. and G. Pedersen, 2000. Problems related to poultry production at village level. Possibilities Proc. of smallholder poultry projects in Eastern and Southern Africa, 22-25 May 2000, Morogoro, Tanzania.
3. Gueye, E.F., 2003. Production and consumption trends in Africa. *World Poult*, 19(11): 1214.
4. Alemu, Y., 1995. Poultry production in Ethiopia. *World's Poultry Science Journal*, 51: 197-201.
5. Halima, H.M., 2007. Phenotypic and genetic characterization of indigenous chicken populations in North-West Ethiopia. Ph.D Thesis. Submitted to the faculty of natural and agricultural sciences department of animal, wildlife and grassland Sciences. University of the Free State, Bloemfontein, South Africa.

6. FAO, 2007. Poultry sector country review, Animal Production and Health Division, Emergency center for trans-boundary animal diseases socio economics, production and biodiversity unit, Food and Agriculture Organization of the United Nations, Rome., Italy. Sources: <ftp://ftp.fao.org/docrep/fao/011/ai320e/ai320e00.pdf>
7. Tadelles, D., 1996. Studies on village poultry production systems in the central highlands of Ethiopia. M.Sc. Thesis, Swedish University of Agricultural Sciences.
8. Alemu, Y. and D. Tadelles, 1997. The status of poultry research and development in Ethiopia. Research bulletin No. 4, Debre Zeit, Ethiopia.
9. Arsham, H., 2002. Descriptive Sampling Data Analysis. Statistical Thinking for Managerial Decision Making. Retrieved November 30, 2011, from <http://ubmail.ubalt.edu/harsham/Business-stat/opre504.htm#rwhyrrsm>.
10. Spss (Statistical Procedures for Social Sciences), 1996. SPSS User's guide version 15.0. SPSS Institute Inc., Cary NC.
11. Muchadeyi, F., C. Wollny, H. Eding, S. Weigend, M. Makuza and H. Simianer, 2007. Variation in village chicken production systems among agro-ecological zones of Zimbabwe. *Trop. Anim. Health and prod.*, 39: 453-461.
12. Khandait, V., S. Gawande, A. Lohakare and S. Dhenge, 2011. Adoption Level and Constraints in Backyard Poultry Rearing Practices at Bhandara District of Maharashtra (India). *Res. J. of Agri. Sci.*, 2(1): 110-113.
13. Gueye, E.F., 1998. Village egg and fowl meat production in Africa. *World's Poult. Sci.*, 54: 73-86.
14. Central Agricultural Census Commission, 2003. Statistical report on farm management practices, livestock and farm managements Central Statistical Authority report of 2004-2005, Vol. II, Addis Ababa, Ethiopia.
15. Gueye, E.F., 1997. Diseases in village chickens: Control through ethno-veterinary medicine. *ILEIA Newsletter*, 13(2): 20-21.
16. Halima, H., F.W.C. Nesper, E. Vanmarle-Koster and A.D.E. Kock, 2007a. Villagebased indigenous chicken production systems in north-west Ethiopia. *Trop. Anim. Health Prod.*, 39(3): 189-197.
17. Meseret, M., 2010. Characterization of Village Chicken production and marketing system in Gomma Wereda, Jema Zone, Ethiopia. Master Thesis, Jimma University, Ethiopia.
18. Khalafalla, A.I., S. Awad and W. Hass, 2001. Village poultry production in Sudan. Department of Microbiology, Faculty of Veterinary Science, University of Khartoum, Khartoum North, Sudan. Accessed on 25th August, 2007.
19. Tadelles, D., T. Million, Y. Alemu and K.J. Peters, 2003. Village chicken production systems in Ethiopia: 2. Use pattern and performance evaluation and chicken products and socio-economic functions of chicken. *Livestock Research for Rural Development*. 15(1): <http://www.cipav.org.co/lrrd/lrrd15/1/tadeb151.htm>
20. Njenga, S.K., 2005. Productivity and socio-cultural aspects of local poultry phenotypes in coastal Kenya. M.Sc. Thesis. The Royal Veterinary and Agricultural University, Copenhagen, Denmark.
21. Mapiye, C. and S. Sibanda, 2005. Constraints and opportunities of village chicken production systems in the smallholder sector of Rushinga districts of Zimbabwe. *Livestock Research for Rural Development*. Volume 17, Article #115. Retrieved February 27, 2003, from <http://www.lrrd.org/lrrd17/10/mapi17115.htm>
22. Moges, F., T. Azage and D. Tadelles, 2010b. Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 24. Nairobi, Kenya, ILRI.
23. Moges, F., M. Abera and D. Tadelles, 2010a. Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North west Ethiopia. *African j. Agri. Res.*, 5(13): 1739-1748.
24. Badubi, S.S., M. Rakereng and M. Marumo, 2006. Morphological characteristics and feed resources available for indigenous chickens in Botswana. *Livest. Res. Rural Dev.* 18(1), <http://www.cipav.org.co/lrrd/lrrd18/1/badu18003.htm>.

25. Atteh, J.O., 1989. Rural poultry production in western middle belt region of Nigeria. Proc. International workshop on rural poultry development in Africa, 13-16 November 1989, Iie-Ife, Nigeria, pp: 211-220.
26. Bell, J.G. and I. Abdou, 1995. Dynamics of village poultry production in the Keita region of Niger. Nigerian J. Anim. Prod., 22: 141-144.
27. Tadelle, D. and B. Ogle, 2001. Village poultry production systems in the central highlands of Ethiopia. Trop. Anim. Hlth Prod., 33(6): 521-537.
28. Solomon, D., 2007. Suitability of hay-box brooding technology to rural household poultry production system. Jimma University College of Agriculture and Veterinary Medicine, Jimma, Ethiopia.