Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.17, 2015

Assessment of Common Practices of Egg Incubation and Chick Brooding of Backyard Poultry Production System in Wolaita Zone, Southern Ethiopia

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Abstract
A survey was conducted in Wolaita Zone, Southern Ethiopia to assess local egg selection practices, brooding practices, practices of breaking broodiness, techniques of egg fertility testing, and factors related with incubation. A multi-stage sampling procedure was employed to select weredas, sample kebeles and respondents in which the three weredas were selected by purposive sampling technique. Pretested structured questionnaire and focused group discussion were employed to generate data. All generated survey data were analyzed using descriptive statistics of SPSS 20. Broody hens were the only means of egg incubation and chick brooding. Broody hens were selected based primarily on body size, broody character, ability of defending predator and number of eggs laid from which broody character predominates the other parameters. Eggs laid at home were the predominant source of egg for incubation and selected mainly based on size, shape and season in which the egg is laid. A bamboo basket bedded with teff straw, a nest on the ground and a nest under bed were the common laying nest preparations. Farmers practiced to store eggs in either directly on the laying nest, in cold room and on the grain. The preferable season of allowing broody hen to hatch was from October to December because of better feed access, less predator and better chick survivability. Majority of the farmers practice cleaning the egg by cloth as treatment. Shaking the egg was the commonly used method of checking egg fertility. Farmers attempt to increase egg production by stimulating broody hens to resume laying through various practices from which moving to neighbors was the most common.
Keywords: Breaking Broodiness, Broody hen, Egg selection Criteria, Egg storage, Fertility assessment and Priority index

1. Introduction

Poultry production has an essential economic, social and cultural benefit and plays a significant role in family nutrition in the developing countries. In many countries of the world, poultry are kept as scavengers in and around the residence areas at village and family level (Kitalyi, 1998). With an estimated total population of 1.6 billion at the end of 2010, village chicken is the most abundant species in Africa, contributing a significant part of the continents economy (FAOSAT, 2012).

Under circumstances of extreme poverty where people cannot keep larger species of livestock due to shortage of land and capital, village chicken provide high quality animal protein at the source of production and income for household activities such as education, health and clothes (Copland and Alders, 2005). These benefits from family poultry production go directly to the rural poor, in most cases to the women being most active as caretakers (Gueye, 1998). In addition, chickens are also important for diversifying agricultural production and increasing household food security directly to the rural poor community including increased distribution of resources through involvement of women (Gueye, 1998; Kitalyi, 1998).

Ethiopia has large population of chickens estimated to be 50.38 million (CSA, 2013) with native chickens of non-disruptive breed. With regard to breed, 96.9 percent, 0.54 percent and 2.56 percent of the total poultry were reported to be indigenous, hybrid and exotic, respectively. The contribution of village chickens to farm household and rural economies is not proportional to their high numbers, although they contribute more than 98% of the total meat and egg production in the country (Udo et al., 2006). This is mainly due to low productivity levels which are the result of diseases, poor management in terms of feeding and housing, poor growth rates and predation.

The use of broody hens to incubate eggs and to rear chicks is common in Ethiopia (Meseret 2010 and Addisu *et al*. 2013).The profitability of a poultry farm is dependent on the hatchability of the breeding hens and the degree of chick survivability. Thus, information on knowledge of local egg selection practices, practices of egg storage, ways of breaking broodiness, methods of egg fertility testing, incubation practices, rate of hatchability and techniques of chick brooding are paramount important in identifying interventions areas use as a baseline information for improvement programs so as to ensure sustainable improvement and utilization village poultry. Little researches have been done on incubation and brooding practices of village chickens under scavenging system in Wolaita Zone. Thus, this study was aimed to assess local egg selection practices, brooding practices, practices of brooding breaking, techniques of egg fertility testing, and factors related with incubation in Wolaita Zone.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Wolaita zone which is located 390 km southwest of Addis Ababa and 165 km from Hawassa. It has a total area of 4,541km^2 and is composed of 12 woredas and 3 registered towns. It is approximately 2000 meters above sea level and its altitude ranges from 700-2900 meters. The population of Wolaita zone is about 1,527,908 million of which 49.3% are male and 51.7% are female (CSA, 2007). Out of these, 11.7% live in towns and the rest 88.3% live in rural areas. The annual population growth rate of the zone is 2.3%. It is one of the most densely populated areas in the country with an average of 290 people per km^2. The area is divided into three ecological zones: *Kola* (lowland <1500m), *Woina Dega* (mid-altitude 1500-2300m) and *Dega* (highland > 2300m). Most of the area lies within the mid altitude zone. Rainfall is bimodal, with an average amount of about 1000mm. Mean monthly temperature varies from 26 ^{0}C in January to 11^{0}C in August. Soils (mainly Vertisols and Nitosols) vary in pH from 5-6. Primary occupation of the zone is farming. Mixed crop-livestock production predominates, but there are some pastoralists in the lowlands. Generally, the climatic condition is conducive to livestock production.

2.2. Sampling method

At the beginning of the study pilot survey was undertaken to understand and update the existing information about poultry production. Multi-stage sampling was employed for overall sampling procedure. From the total 12 woredas, 3 representative woredas were selected purposively based on the experience and intensity of poultry production that obtained from the woreda bureau of agriculture as information. Two kebeles from each selected wereda were selected randomly. From the selected 6 kebeles, 135 households were selected randomly for interview.

2.3. Data Collection Method

The primary data were collected by using structured questionnaire, observation and interview from 135 randomly selected respondents. The secondary data were collected from reviewing published and unpublished sources and reports of the wereda agricultural office.

2.4. Statistical Analysis

Data collected were analyzed using SPSS version 20 software. Survey results were reported using descriptive statistics such as frequency and percentage and presented in the form of tables, graphs and charts. A priority index was used to rank the preference of parameters to select broody hen, severity of problems that all hatched chicks do not grow and common measures taken to break broodiness based on their relative importance or seriousness using the following formula:

Priority index (PI) = $\dfrac{(F1X3) + (F2 X 2) + (F3 X1)}{F\ total}$

Where:

F1= Frequency of the first rank; F2= Frequency of second rank; F3 = Frequency of third rank and FT= Frequency of total respondents.

3. Result and Discussion

3.1. Flock Size and Purpose of Keeping Poultry in the Study Area

The results of this study showed that the mean flock size per household was 8 chickens which is comparable to the mean flock size of Nebiyu *etal.* (2013), who reported mean flock size of 8.53 in Halaba district of Southern Ethiopia. Similarly, Abera *etal.* (2012) reported that the average flock size per household in different agro-ecologies of Ethiopia was 7.9. However, the flock size is lower than the study of Mathewos *etal.*(2015) and Samson and Endalew (2010) who reported the flock size 10 and 13 respectively.

The purposes of keeping poultry by households as indicated in Table 1 were for different reasons in the study area. Most of the respondents gave the highest priority for income generation (55 %) followed by home consumption (22%). The result is in agreement with the result of Fisseha (2009) who reported that sale of live birds as source of income was the first most important function (51%) of rearing chicken in Bure woreda. The result is also consistent with the study of Moges *etal.* (2010) who reported that the sale of live chicken was the first important function of rearing chicken in Fogera area. Similarly, Halima *et al.* (2007) and Melese and Melkamu (2014) with their studies in different areas reported that, income generation and household consumption are the main production objectives of keeping village chicken in Ethiopia. Minimum priority was given for incubation and security (6.7 %). This result is different from the report of Kibret (2008), who reported that the main function of chickens for farmers is provision of meat and egg for home consumption.

Table 1: Purpose of Keeping Poultry in the Study Area

No	Purpose of poultry keeping	Frequency	Percent
1	Home consumption	30	22.2
2	Income generation	75	55.6
3	Security	9	6.7
4	Incubation	9	6.7
5	All	12	8.9
Total		135	100.0

3.2. Source of Egg for Incubation and Egg selection Criteria

From the result of the current study, it is observed that all respondents use broody hen for incubation; the practice of artificial incubation is uncommon which is in agreement with the study of Shishay *etal*.(2014) and Mulugeta and Tebkew (2013) who reported that farmers entirely depend on broody hens for hatching of chicken eggs. The sources of eggs for incubation were either home laid eggs (68%), purchased from market (22%) or purchased from government (9.6%) in the study area (Table 2). Similar result was reported by Solomon *etal. (*2013) that 90% of the households responded that the source of egg for incubation in Metekel zone is home laid.

Table 2: Source of Egg for Incubation

No	Source of incubation eggs	Frequency	Percent
1	Home laid	92	68.1
2	Purchased from market	30	22.2
3	Purchased from government	13	9.6
Total		135	100.0

From the result of the study, majority of the respondents had practices of selection of eggs before incubation. Fifty three percent of the respondents selected incubation eggs based on size, shape and season in which the egg is laid whereas 23 % selected based on age of the egg and 16% selected based on size of the egg only as indicated in Table 3. Large sized eggs were more selected than medium and small sized eggs. Similar to this study, Addisu *et al* (2013) also reported that 88.24% of the village chicken owners of North Wollo zone had a practice of egg selection based on egg size.

Table 3: Hatching egg selection criteria

No	Criterion for hatching egg selection	Frequency	Percent
1	Size of the egg only	22	16.3
2	Age of the egg only	31	23.0
3	Size and shape of the egg	10	7.4
4	Size, shape and season of laying of the egg	72	53.3
Total		135	100.0

3.3. Laying Nest Management and Egg Storage

A laying nest for broody hen is prepared from different materials and placed in different manners. According to the study, as indicated in Figure 1, a bamboo basket bedded with teff straw (58%), a nest on the ground (12%) and a nest under bed (19%) were the common laying nest preparations. Changing the bedding materials during incubation was practiced by all respondents. This result is in agreement with Tadelle *et al.* (2003) who reported that bamboo baskets, cartons or even simply a shallow depression in the ground are common materials and locations used as egg setting sites, and crop residues of Tef, wheat and barley straws were used as bedding materials in different agro-ecological zones of Ethiopia.

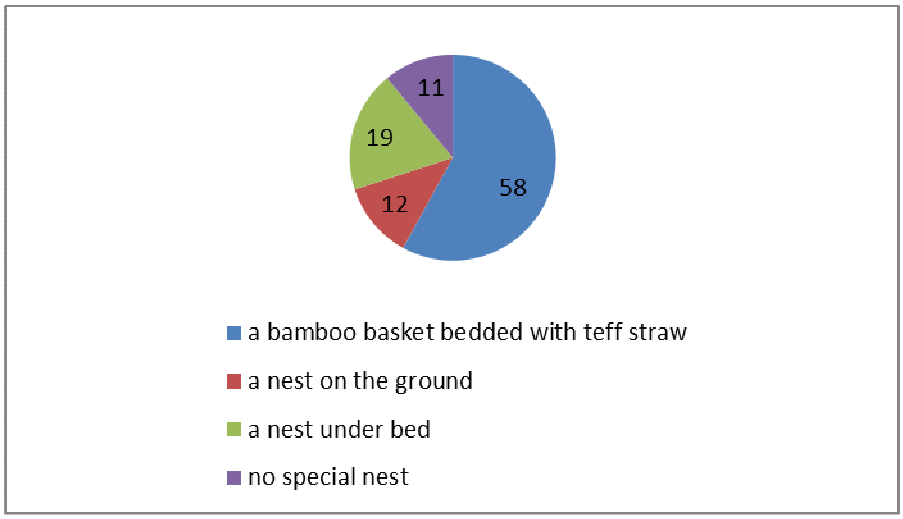

Figure 1: A laying management for broody hen

Shelf life increment of hatching eggs was done by various traditional practices. Farmers practiced to store eggs in either directly on the laying nest (58%), in cold room (8%) and on the grain (33%) as indicated in Table 4. Contrary to this study, Tadelle *et al* (2003) reported that household stored eggs inside grains especially Tef (*Eragrostis tef)* mainly and believed to increase egg shelf lives in different agro-ecological zones of Ethiopia. Moreover, most of the households (71%) positioned eggs on their natural position and 19% did not know the importance of positioning egg during hatching or incubation. The remaining 9.6% of them positioned eggs with the broad end up. Consistent to this study, Shishay *etal*. (2014) reported that most of the households (99.7%) positioned eggs sideways during hatching.

Table 4: Ways of Egg Storage

No	Storage of hatching eggs	Frequency	Percent
1	On the grain	45	33.3
2	On laying nest	79	58.7
3	Cold room	11	8
Total		135	100.0

3.4. Incubation Practices and Hatchability

The preferable season of allowing broody hen to hatch was from October to December (67%) followed by July to September (22%) which is indicated in Figure 2. The respondents pointed out that the season was preferred because of better feed access, less predator and better chick survivability. The result is in agreement with the finding of Meseret (2010) who reported in her study that almost all the respondents believe that the highest percentage hatchability could be obtained from eggs incubated from October to January. Similarly, Abera *etal* (2012) in their study indicated that farmers preferred drier season for hatching because of better feed access and less chick mortality.

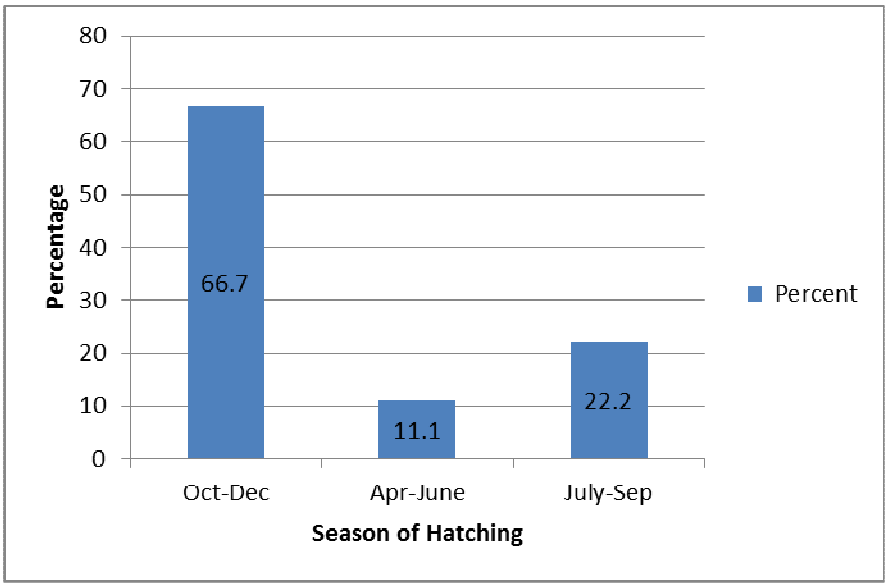

Figure 2: Common Season of Hatching

Washing by cold water, washing by warm water and cleaning the egg by old cloth were the common experiences treating eggs before incubation. Majority of the farmers practice cleaning the egg by cloth (59%), 20% clean by warm water and 19% wash by cold water. Similar findings have been reported by Mamo *etal*. (2011) and Sonaiya and Swan (2004) that farmers were treating (rubbing) the preferred eggs before incubation using dry materials (cloth). However; in contrast to this findings, Dereje (2001) stated that farmers use soaked clothes to treat eggs before incubation.

Number of eggs set for hatching differed among respondents. According to the study, 84% of the respondents replied that they use 8-10 eggs per hatching which is consistent with the findings of Melkamu (2013) and Feleke *etal.,* (2015) who reported that the number of egg set in one hatching was 10. The average hatchability of egg by brooding hen as indicated by majority of the respondents (51%) was 61-65% which is lower than the hatchability value reported by Melkamu (2013) which is 72 %.

Floating on water, shaking the egg, candling by sun and cooking sample of egg were the known ways of egg fertility assessments (Table 5). However, shaking the egg (59%) and sun candling (32%) predominated the other methods. This result is in agreement with the findings of Matiwos *etal.* (2013) in which households identify normal eggs from spoiled by shaking (47.8%). In contrast to this finding, Mamo *etal*. (2011) reported that 61% of the households responded that they could identify normal eggs from the spoiled by the visual observation in South Wollo.

Table 5: Ways of egg fertility assessments

No	Ways of egg fertility assessments	Frequency	Percent
1	Floating on water	6	4.4
2	Shaking	80	59.3
3	Sun candling	44	32.6
4	Cooking a sample	5	3.7
Total		135	100.0

Brooding chicks after hatching is mainly accomplished by the broody hen (86%), followed by provision of special chick brooder (13%). Only one person (0.7%) reported that he used hay box brooder. This result is in agreement with that of Solomon (2007a), who reported that it is by natural incubation and brooding that chicks are hatched and raised all over the rural Ethiopia. According to the study report, fifty percent of the chick hatched grew. Farmers further indicated that the main reasons for the lower survival rate of the chicks were predation, lack of brooding and lack of vaccination with their priority indices of 0.295, 0.260 and 0.239, respectively.

Table 6: Factors of lower chick survivability

NO	Variables	No of respondents				F-sum	PI	Rank
		1st	2nd	3rd	4th			
1	Poor survivability	78	56	44	32	600	0.205	4
2	Predation	100	89	70	55	862	0.295	1
3	Lack of brooding	90	76	62	49	761	0.260	2
4	Lack of vaccination	88	69	51	38	699	0.239	3
Total						2922	1.000	

PI: Priority Index

3.5. Parameters of Broody Hen Selection and Ways of Breaking Broodiness

Brooding hens for incubation were selected by households based on body size, broody character, degree of protection from predators, hatching history and number of eggs laid (Table 7). Farmers gave higher emphasis in selecting broody hens based on broody character (PI= 0.310), followed by hatching history (PI=0.239) and good protector from predators (PI=0.180). Contrary to this study, Meseret (2010) and (Addisu *et al*. 2013) reported that respondents gave the highest priority for body size in selecting broody hen.

No	Variables	No of respondents					F-sum	PI	Rank
		1st	2nd	3rd	4th	5th			
1	Body size	46	36	28	25	17	525	0.127	5
2	Broody character	120	90	68	43	30	1280	0.310	1
3	Good protector from enemy	65	51	42	33	21	742	0.180	3
4	Hatching history	90	67	52	40	31	985	0.239	2
5	Number of eggs laid	54	43	32	22	10	592	0.144	4
Total							4124	1.000	

PI: Priority Index

The traditional practices of breaking broodiness are shown in Table 8. All the respondents reported that they exercise traditional ways of breaking broodiness aimed at increasing egg productivity. From the study, as indicated, sending broody hen to the neighbour was the primary way of breaking broodiness with an index value of 0.259 which is consistent with the report of Mamo *etal*. (2011) and Shishay *etal*.(2014) who indicated that majority of the respondents take broody hen to neighborhoods to break broodiness. Unlike to this study, Matiwos *etal.* (2013) in their study reported that about 30.4% of the respondents exercise disturbing of the broody hen in the laying nest including replacing of eggs with some other foreign materials as a method of breaking broodiness. The second and third ways breaking broodiness were piercing the nose and tying the wings with index values of 0.257 and 0.208, respectively.

Table 8: Ways of Breaking Broodiness

No	Variables	No of respondents					F-sum	PI	Rank
		1st	2nd	3rd	4th	5th			
1	Sending to the neighbour	72	64	55	44	22	891	0.259	1
2	Hanging	38	25	17	9	8	367	0.107	5
3	Disturbing the nest	56	41	30	19	10	582	0.169	4
4	Tying the wings	65	50	39	24	24	714	0.208	3
5	Piercing the nose	65	68	56	44	29	882	0.257	2
Totals							3436	1.000	

PI: Priority Index

4. Conclusion

Broody hens were the only means of egg incubation and chick brooding. Broody hens were selected based primarily on body size, broody character, ability of defending predator and number of eggs laid form which broody character predominates the other parameters. Eggs Laid at home was the predominant sources of incubation and selected mainly based on size, shape and season in which the egg is laid. A bamboo basket bedded with teff straw, a nest on the ground and a nest under bed were the common laying nest preparations. Farmers practiced to store eggs in either directly on the laying nest, in cold room and on the grain. The preferable season of allowing broody hen to hatch was from October to December because of better feed access, less predator and better chick survivability. Majority of the farmers practice cleaning the egg by cloth as treatment. Shaking the egg was the commonly used method of checking egg fertility. Farmers attempt to increase egg production by stimulating broody hens to resume laying through various practices from which moving to neighbors was the most common. Therefore, the study highlighted that an intervention via training need to be

implemented with regard to chick brooding, use of best quality eggs for incubation, chick vaccination general care in increasing hatchability and chick survivability to improve village poultry production.

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