

Assessment of the Prevailing Chicken Egg Storage Materials and Length at Rural Household in Different Agro Ecology of Eastern Ethiopia

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Abstract: Assessment of the prevailing chicken egg storage materials and length at the rural household in different Agro ecological zone of Eastern Ethiopia were conducted to assess the existing local egg storage facilities and length under the rural farmers. From two zone representing Eastern Ethiopia and the lowland, midland and highland altitude, proportionally 10 districts of 30 rural kebeles were selected using probability proportional to sample size. From each selected rural kebeles, ten farmers were purposely selected. A total of 300 chicken owner were interviewed by structured questionnaire. The collected data were analyzed by SPSS software. The majority of the respondents (98%) in Eastern Ethiopia stored eggs for both marketing and incubation in lowland (86.4%), midland (69.3%) and highland (91.2%) using plastic (28.8%), basket (28.4% and (34.1%) followed by basket (25.4%), pot made of clay/ cow dung (23.9% and 23.8%) along with coffee hulls and dried grass as bedding materials respectively. Mostly, eggs produced at home was used for incubation in lowland (75.9%), midland (76.9%) and highland (73.9%); not experienced for home consumption except for household of better economic status and at the festivity in a year, and to some extent purchased eggs from known neighbor where their qualities were evaluated by shaking and sun candling in lowland (53.8%) and midland (46.7%) and sun candling in highland (51.4%). Hatching eggs were stored more than a week in mid (43.1%) and highland (44%) and about a week in lowlands (48.2%) until the required number of egg was produced for incubation by broody hen. Most of the respondents (78%) were select incubating eggs based on size in lowland (44.9%) and color and size in mid (45.7%) and highland (54.4) preferably large size and white eggs. The common hatching materials used in the area was pot in lowland (61.1%), mid (40%) and highland (53%). Due to suitable weather condition, better hatchability, less disease and parasite infestation and better feed resource availability, most of the respondent (70%) performed incubation during the dry season. Generally, rural poultry producer used different egg storage and hatching materials for different duration, they may influence the quality of eggs for uses that require further investigation to evaluate and recommend the best methods of storage material and duration across different agro ecology and provision of successful training for rural poultry producer; women, on modern egg storage and incubation for improvement of poultry production.

Keywords: Agro-Ecology, Egg Storage Material and Length, Eastern Ethiopia

1. Introduction

The world poultry population has been estimated to be about 16.2 billion, with 71.6% in developing countries, producing 67,718,544 metric tons of chicken meat and 57,861,747 metric tons of hen eggs [1]. In Africa, village poultry contributes over 70% of poultry products and 20% of

animal protein intake [2]. In East Africa, over 80% of human population lives in rural areas and over 75% of these households keep free range indigenous chickens [2-3] where Ethiopia is not exceptional.

Ethiopia has about 56.53 million of chicken population,

where the 94.31% of them are indigenous chicken breeds kept in rural area and the rest of 3.21% and 2.49% of the total poultry are hybrid and exotic, respectively [4]. These traditional indigenous chicken production systems, the most widespread and almost every rural family owns and provide a valuable source of family protein and income and contribute the major national egg and poultry meat production as well as supply sufficient and balanced protein for the human health.

However, the contribution of poultry sector to human nutrition and export earnings is not proportional to the huge chicken numbers. This is attributed to the presence of different constraints like breed and age of the flock, type and amount of feed, incidence of disease, management control of the laying flock and handling of eggs. On the other hand, from poultry product, eggs provide means through which the animal protein of the populace can be met due to its essential nutrient contents and supports life during embryonic growth [5] and one of the most palatable, nutritious and complete food of animal protein known to man. Eggs are balanced sources of almost all essential amino acids as well as some minerals and vitamins [6]. Hence, egg proteins are used as standard for measuring the nutritional quality of other food products [7-8].

In the absence of refrigeration, local egg storage materials and practices are used in developing country, where Ethiopia is not exceptional, to keep the eggs cool until the time of selling and incubation and increase the shelf life and hatchability rate of the eggs. Likewise, in Ethiopia, different type of local materials is used for the storage of eggs until it is marketed and the hen is ready for brooding. The study conducted in north part of Ethiopia revealed that all farmers collected the eggs on daily basis and 77.5% of them stored the eggs in container mixed with grains, 8.1% stored in mixed with flour, 11.9% stored in different available material and exceptionally 5% of the households in lowland stored the egg mixed with sand placed on any container [9]. About 87.4%, 38.9% and 98.1% of village chicken owners in Bure, Fogera and Dale woredas, respectively, destined eggs for incubation and marketing are stored inside earthen material (clay) together with grains/straws and the other preferred containers until the hen finishes laying and starts broodiness [10]. Sand was also used almost by all farmers as bedding material to keep the environmental temperature low and maximize hatchability [9]. Such practices have positive impact on increasing the shelf life and hatchability rate of the eggs since storage time can influence the viability of the eggs by reducing the thick white content of the eggs and on the other hand by increasing the amount of thin white and air space inside the eggs.

However, despite the chicken eggs are more numerous produced and selling in the area to date, there is no sufficient studies conducted on the prevailing egg storage materials and duration. Thus, this study was designed with the objectives of assessing the prevailing local egg storage facilities and storage length under the rural farmers' level in Eastern part of Ethiopia.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in two zone; East and West Hararghe, of ten districts of low land, midland and high land agro-ecology of Eastern Ethiopia. West Hararghe zone is located at 326 km away from the capital Addis Ababa and Chiro is the capital of the zone. The zone has 17 districts and 435 kebeles. The total human population of the zone is about 2,260,649 of which 1,155,038 are male and 1,105,611 female [11]. Agriculture is the dominant economic activities mainly mixed type of farming where 55 – 65% of the livelihood is depend on food crops production, 12 – 15% livestock production, 10 -15% cash crops (including fruits & vegetables) and 5% pity trade in high and midlands. Sorghum, Maize, Wheat, Teff, Haricot bean, *khat* and coffee productions are the dominant cereal crop and cash crop respectively. Agro-ecologically, the zone is classified as 11.14% highland (dega) 38.67% midland (Weina Dega) and 54.13% lowland (kolla). The altitude ranges from 1200 to 3060 meters above sea level with the average range of annual rainfall of 850 – 1200mm with bimodal distribution during Belg and Meher seasons. Mean temperature varies between 20.5°C and 24.5°C [12].

Similarly, East Hararge Zone is located at 526 km away from the capital Addis Ababa and Harar is the capital of the zone. The zone has 19 districts and 534 kebeles. The total human population of the zone is 3,286,338 of which 1,664,365 are male and 1,621,973 female [11]. Agriculture is the dominant economic activities mainly mixed type of farming where most of the livelihood is depend on food crops production and some on livestock production. The zone is classified in to three type of agro-ecology as highland, midland and lowland. The average range of annual rainfall and temperature is 700 – 900mm and 10°C – 26°C respectively [13].

2.2. Data Collection Methods and Procedures

The study was accomplished through interview using structured questionnaires augmented with focus group discussion with Development agents. The surveyed districts of the zone was stratified into highland, midland and lowland agro-ecological zones that help to select sampled districts by using probability proportional to sample size; and the interviewees were selected from highland, lowland and midland agro-ecological zones, respectively through purposive sampling methods. Then Peasant Associations was selected purposely based on the potential for poultry production, relatively larger household numbers, accessibility and infrastructure. Finally, a total of 300 household were interviewed to collect data on socio-economics, egg storage methods and facilities used and storage period.

2.3. Statistical Analysis

All collected data was analyzed using Statistical Package for Social Sciences [13] package. Descriptive statistics such

as mean, frequency distribution and percentage was used to report the results.

3. Result

3.1. Socio Economic Characteristics of Respondents

A total sample size of rural household respondent handled during the survey in East and West Hararghe zone of low, mid and high land of ten districts were 300. Out of the total sample respondents, female comprised 55.7% (n=97) in East and 44.3% (n=77) in West Hararghe zone of the Eastern part of Ethiopia that revealed that females were participated in poultry production activities (58%) than male in Eastern Ethiopia indicating that female are playing a prominent role in poultry rearing. From interviewed respondents, 95.3% were married while 3.3%, 0.7% and 0.7% of the respondent

were Widowed, divorced and polygamy respectively.

Regarding the level of education, 40.3% of the interviewed respondent had not received any formal or informal education which was high in lowland area (60%) followed by mid land (36.7%) and highland area (34.7%) indicating respondent in low land area had given less attention for education may be due to the majority of the dweller given priority for livestock rearing particularly for cattle and small ruminant including camel. The remain 29%, 21.7% and 9% of the respondents were attended primary first and second cycle education (1-8 grade), basic education and secondary education respectively (Table 1). This result indicated that educated farmers in mid and highland area performed poultry activity than lowland area may be due to the majority of the people give priority for cattle and small ruminant production including camel than poultry.

Table 1. Socioeconomic profile of the respondents in the study areas.

Parameter	Category	Agro ecology						Overall	
		Lowland		midland		highland			
		N	%	N	%	N	%	N	%
Sex	Male	22	33.3	38	42.2	66	44	126	42
	Female	38	63.3	52	57.8	84	56	174	58
Educational Status	Illiterate	36	60	33	36.7	52	34.7	121	40.3
	Writing and reading	15	25	18	20	32	21.3	65	21.7
	1-8grade	6	10	31	34.4	50	33.3	87	29
	9-12grade	3	5	8	8.9	16	10.7	27	9
	Married	56	93.3	87	96.7	143	95.3	286	95.3
Marital status	Polygamy	1	1.7	1	1.1	-	-	2	0.7
	Widowed	3	5	1	1.1	6	4	10	3.3
	Divorced	-		1	1.1	1	0.7	2	0.7

N= Number of respondent in agro ecology, % = Percentage

The mean of the age of the respondents in low land, midland and highland area of the respondent were 40.2, 37.2, and 39.2 with the average family size of were 5.8, 6.7 and 6.5 respectively (Table 2). These ages composition indicates that the respondents engaged in poultry activity were in a potential productive ages. As the result indicated, the average family size of the respondent in the study area were 5.8, 6.7 and 6.5 in the three agro ecology of the area (Table 2) indicating high family size both in mid and highland area may be due to the favorable climatic condition.

Table 2. Age and family size of the respondents.

Agro ecology	Category	N	Minimum	Maximum	Mean	+SEM
Low land	Age	60	26	58	40.2	1.13
	Family size		2	9	5.8	0.24
Mid land	Age	90	25	60	37.2	6.7
	Family size		0	12	6.7	0.21
High land	Age	150	25	62	39.2	7.8
	Family size		0	12	6.6	0.21
Over all	Age	300	25	62	38.4	0.46
	Family size		0	12	6.5	0.13

N: number of respondent in agro ecology; SEM: Standard Error of Mean

3.2. Flock Size, Purpose of Rearing and Responsible Family for Chicken Management

The overall average number of chicken per household was 8.8 ± 2.9 SEM with a minimum of 3 and a maximum of 20 and the mean flock composition per household for chicks pullets, cockerels, hens and cocks was 7.11 ± 1.3 SEM, 8.4 ± 1.4 SEM, 2.7 ± 0.3 SEM, 6.2 ± 0.97 SEM and 2 ± 0.4 SEM respectively indicating the respondent engaged in poultry production.

The purposes of rearing chicken by the respondent were for income generation and home consumption in the study area. As the result revealed, most of the respondents gave the highest priority for sale of both eggs and live chicken (67%) used to purchase food items, cover educational expense for children's and other followed by home consumption (33%) This was the highest in lowland (75%) followed by highland (66%) and midland (63.3%) may be due to the suitable climatic condition and economic status difference with agro ecology.

Concerning the management of chicken, as the result indicated in Table 3, men were mainly responsible in the construction of night resting place which account 46.7% in low land, 67.8% in midland and 70.7% in highland area. Children also shared the responsibility of chicken house construction following men. Women were performed most of

the other management activities in chicken rearing. They dominated in feeding and watering (81.7, 71.3 and 57.8%), keeping the sanitation (71.7, 60 and 77.3%) and treatment of sick birds (58.3, 76.7 and 85.3%) as well as decision making

for selling and buying (85, 81.1 and 81.3%) in lowland, midland and highland respectively that indicate women play an important role in indigenous chicken production followed by children in the rural area of Eastern Ethiopia.

Table 3. Responsibility of family in chicken management.

Parameter		Agro ecology						overall	
		Lowland		midland		highland			
		N	%	N	%	N	%	N	%
Construction of house, perch if so	Men	28	46.7	61	67.8	106	70.7	195	65
	women	13	21.7	4	4.4	3	2	20	6.7
	Children	19	31.6	25	27.8	41	27.3	85	28.3
Feeding and watering	Men	5	8.3	19	21.1	24	16	48	16
	women	49	81.7	52	57.8	107	71.3	208	69.3
	Children	6	10	19	21.1	19	12.7	44	4.7
Cleaning	Men	-	-	-	-	-	-	-	-
	women	43	71.7	54	60	116	77.3	213	71
	Children	17	28.3	36	40	34	22.7	87	29
Treating sick birds	Men	7	11.7	7	7.8	6	4	20	6.7
	women	35	58.3	69	76.7	128	85.3	232	77.3
	Children	18	30	14	15.5	16	10.7	48	16
Decision making for selling and buying	Men	3	5	16	17.8	9	6	28	9.3
	women	51	85	73	81.1	122	81.3	246	82
	Children	6	10	1	1	19	12.7	26	8.7

N= Number of respondent in agro ecology, % = Percentage

3.3. Hatching Egg Storage and Management Practices

The result of this study revealed that, the majority of the respondents (98%) were stored eggs in Eastern Ethiopia. The purpose of those stored eggs were mainly used for both marketing and incubation in lowland (86.4%), midland (69.3%) and highland (91.2%) (Table 4). But, the experience of local chicken production in the Eastern part of the country is not for home consumption except for household of better economic status and during the festivity in a year where the household head given priority followed by children.

The majority of egg storage materials before incubation were pot made of clay and dung, plastic, basket, carton, 'buke' (gourd) depending on the availability. The most widely used storage materials in low land, midland and highland were plastic (28.8%), basket (28.4%) and basket made of bamboo (34.1%) followed by basket (25.4%), pot made of clay or cow dung (23.9%) and pot (23.8%) along with coffee hulls and dried grass as bedding materials respectively as indicated in Table 4.

Table 4. Purpose of storage and type of Egg storage materials.

Parameters	Category	Agro ecology						Over all	
		Lowland		Midland		Highland			
		N	%	N	%	N	%	N	%
Did you store the egg	Yes	59	98.3	88	97.8	147	98	294	98
	No	1	1.7	2	2.2	3	2	6	2
Purpose of egg storage	Home consumption	2	3.4	6	6.8	8	5.4	16	5.4
	Marketing	3	5.1	17	19.3	5	3.4	25	8.5
	Incubation	3	5.1	4	4.5	10	6.8	17	5.8
	Marketing and incubation	51	86.4	61	69.3	124	91.2	236	80.3
	pot	9	15.3	21	23.9	35	23.8	65	22.1
Type of egg storage materials	Plastic	17	28.8	16	18.2	26	17.7	59	20
	Basket	15	25.4	25	28.4	50	34.1	90	30.6
	Carton	11	18.6	15	17.0	18	12.2	44	15
	In grain	-		8	9.1	13	8.8	21	7.1
	Buke/Gourd	7	11.9	3	3.4	5	3.4	15	5.1

N= Number of respondent in agro ecology, % = Percentage

3.4. Hatching Egg Source, Storage Length and Selection Criteria

The egg used for incubation as indicated in Table 5 were from different sources like purchased from the neighbor,

produced at home and purchased from market. But, the majority of the respondents used egg produced at home in lowland (75.9%), midland (76.9%) and highland (73.9%) followed by purchased known eggs from neighbor for incubation purposes after testing its quality through a means

of shaking and sun candling in lowland (53.8%) and midland (46.7%) and sun candling in highland (54.4%) area.

As the result indicated, the eggs laid by local breed at home and used for incubation was stored for more than nine days (44.7%) before setting. Agro ecologically, the result revealed that 43.1% and 44% of the respondent stored egg for more than a week in both mid and highland area and

almost equal size of respondents (46.3 and 48.2%) stored egg for the same length; 1 to 8 and 9 to 16 days, in lowland respectively until the required number of egg was produced for incubation. Almost, the entire respondent used broody hen for incubation and the practices of artificial incubation is not common even in the area where there is electric power supply.

Table 5. Hatching egg Source, quality assessment, storage length, selection and treatment.

Parameters	Category	Agro ecology						overall	
		Lowland		Midland		Highland			
		N	%	N	%	N		N	%
Source of egg for incubation	Purchased from neighbor	9	16.7	13	20	30	22.4	52	20.6
	Laid at home	41	75.9	50	76.9	99	73.9	190	75.1
	Purchased from market	4	7.4	2	3.1	5	3.7	11	4.3
If purchased incubated egg, how do you test quality	Sun candling	4	30.8	4	26.7	18	51.4	26	41.3
	shaking	-		3	20	8	22.9	11	17.5
	Shaking and sun candling	7	53.8	7	46.7	6	17.1	20	31.7
	Floatation	2	15.4	1	6.7	3	8.6	6	9.5
Length of egg storage before incubation	1-8days	25	46.3	25	38.5	34	25.4	84	33.2
	9-16days	26	48.2	28	43.1	59	44	113	44.7
	More than 17days	3	5.5	12	18.4	41	30.6	56	22.1
Do you select hatching eggs	Yes	35	71.4	46	70.8	103	76.9	184	74.2
	No	14	28.6	19	29.2	31	23.1	64	25.8
	Shape	4	11.4	6	13	12	11.7	22	12.0
If yes, criterion for selection	Storage age	4	11.4	5	10.9	12	11.7	21	11.4
	Size of egg	22	44.9	14	30.4	23	22.3	59	32.1
	Color and egg size	5	14.3	21	45.7	56	54.4	82	44.6
Do you treat egg before incubation	yes	13	24.1	24	36.9	63	47.1	100	39.5
	No	41	75.9	41	63.1	71	52.9	153	60.5
If yes, type of treatment	Washing with water	6	46.2	8	33	16	25.4	30	30
	Cleaning with dry cloth	7	53.8	16	66.7	47	74.6	70	70

N= Number of respondent in agro ecology, % = Percentage

Before incubating the egg, more than 74.2% of the respondents were select the egg in the study area based on shape, size, storage age and color. But, most of the respondents were selected the eggs based on size of egg in lowland (44.9%) and both the color and size in mid (45.7%) and highlands (54.4%). Large size and white color egg was given priority in low land (53.7%), midland (60%) and highland (59.5%).

In Eastern Ethiopia, most of the respondent (60.5%) was not experience to treat eggs before incubation. This is high in low land (75.9%) followed by midland (63.1%) while respondent in highland had better experience in hatching egg treatment than the two may be better exposure to extension service as a result office proximity. The common treatment used was washing with cold water and cleaning with dry cloth. Cleaning with dry cloth (70%) was more practiced than washing in the area which was high in mid (66.7%) and highland (74.6) area.

Almost all respondents have never observed the position of eggs during incubation as well as at storage may be due to the farmers did not know the effect of egg position during

incubation and storage on the hatchability.

3.5. Incubating Material and Brooding Management

As the result indicated on Table 6, the type of incubating materials in the rural area of Eastern Ethiopia was pot, basket carton and shallow depression on ground. The common materials used as hatching egg setting was pot made of clay and cow dung in lowland (61.1%), mid (40%) and highland (53%) area with grass in low and mid land and grass and straw in highland as bedding materials depending on its availability. The trend of changing bedding material was not commonly practiced. Egg setting material was placed close to fireplace or in protected dark area.

More than 80% of the respondent of the current study select broody hen based on body size, broody behavior and previous hatching ability in all agro ecology. But, body size was the main criterion used. The practice of selecting broody hen based on its size was high in highland (88.8%) followed by mid (73.8) and low in low land (66.7%) in decreasing rate as agro ecology change from highland to lowland.

Table 6. Egg hatching material and brooding management.

Parameters	Category	Agro ecology						Over all	
		Lowland		Midland		Highland			
		N	%	N	%	N	%	N	%
Incubated egg materials	Pot with straw/grass	33	61.1	26	40	71	53	130	51.4
	Basket with straw/grass	6	11.1	11	17	24	18	41	16.2
	On ground with straw/grass	9	16.7	12	18.4	23	17.1	44	17.4
	Carton	6	11.1	16	24.6	16	11.9	38	15.0
Where do you set/place the broody material?	In dark and protected corner	50	92.6	45	69.2	90	67.2	185	73.1
	In light and protected corner	4	7.4	20	30.8	44	32.8	68	26.9
When is the incubation season in a year	At rainy season	2	3.7	-	-	5	3.7	5	2.0
	At dry season	39	72.2	45	69.2	92	68.7	176	70.1
	When egg is available	13	24.1	20	30.8	37	27.6	70	27.9
Is there seasonal variability on hatchability	yes	49	90.7	47	72.3	92	68.7	188	74.3
	No	5	9.3	18	26.7	42	31.3	65	25.7
If yes, at which the highest hatchability exhibit	At rainy season	2	4.1	-	-	7	8.6	9	5.1
	At dry season	46	93.9	33	70.2	58	70.7	137	76.9
	Not noticed yet	1	2.0	14	29.8	17	20.7	32	17.0
Type of feed used for rearing chicken	Grind grain	11	20.4	21	32.3	72	53.7	104	41.1
	Water soaked Enjera	23	42.6	38	58.5	60	44.8	121	47.8
	Scavenging	20	37	6	9.2	2	3.1	28	11.1
	Hanging the bird	32	53.3	31	34.4	35	23.3	98	37
Practices to avoid broodiness of hen if not used	Depriving from feed & water	2	3.3	7	7.8	5	3.3	14	4.7
	Disturbing in the nest	15	25	10	11.1	32	21.3	57	19
	Moving to neighbors	-	-	11	12.2	27	18	38	12.7
	disturbing and moving to neighbor	2	3.3	6	6.7	23	15.3	31	10.3
	disturbing and hanging	9	15	25	27.8	28	18.7	62	20.7

In Eastern Ethiopia, the entire respondent practices natural incubation system using broody hens. About 70% of the respondent preferred to allow broody hen to hatch during the dry season due to seasonal variability on hatchability as respondent reported in lowland (90.7%), mid (72.3%) and (68.7%) which is better hatchability during the dry season in lowland (93.9%), midland (70.2%) and highland (70.7%), less chicken mortality due to less disease and parasite infestation, less environmental temperature problem and better feed resource availability as compared with rainy season.

During rearing period, the respondent used water soaked Enjera and grain of maize and sorghum, depending on the availability and scavenging most of the time in a day and also provides water intermittently. From these feed source, water soaked Enjera is the common feed sources in lowland (42.6%) and mid land (58%) while almost both grain and water soaked Enjera in highland. But, during incubation period broody hen rely mainly on scavenging house left over grain and supplementation was not practiced in the area like the period of egg laying.

Traditionally, rural poultry producer practice different means of breaking broodiness like handing the birds downward and depriving from water and feed, disturbing the egg laying nest and moving to neighbors to increase egg production. As the result indicated in Table 6, the common type used in Eastern Ethiopia was handing the birds in lowland (53.3%), midland (34.4%) and highland (23.3%) followed by disturbing the nest in lowland (25%) and highland (21.3%) and both disturbing the nest and hanging the birds is refuse to leave during disturbing the nest.

4. Discussion

The result of this finding indicated that poultry rearing in Eastern Ethiopia was undertaken by females (58%) with the average chicken holding of 8.8 ± 2.9 SEM which was higher than 5.56, 6.23 and 5.6 [15, 16] and lower than 9.92, 12.38, 33.5, 26.1, 24.2, 23.14, and 30 [10, 18-23] respectively.

The primary purpose of rearing poultry were for sale of both eggs and live chicken (67%) to generate income for food and educational expense especially in lowland agro ecology (75%) due to the unsuitable climatic condition and low economic status than the two agro-ecology as some finding indicated that the overall purpose of keeping poultry by poor group (46.2%), medium (35.0%) and rich (44.3%) were for sale, religious and home consumption, respectively [24]. This implied that the contribution of poultry to improve the protein need of the rural farmer of lowland area was less than the two-agro ecology due to the primary objective of raising chicken was for sale of egg and live chicken and consumption of egg was given secondary importance. Likewise, the purpose of keeping poultry by most of the respondents in different area was mainly for sale of live chickens and eggs for income generation and also for hatching and home consumptions as reported [10, 15, 24-27]. But it is different from the finding of Kibret B [28] who revealed that the primary function of poultry production by farmer is provision of meat and egg for home consumption.

In the management of chicken, men were mainly responsible in the construction of night resting place followed by children that was low in lowland (46.7%) and high in highland (70.7%). The variation of this result in the agro-ecology was due to men and children given priority in

looking after livestock in lowland. Women were performed most of the other management activities like feeding and watering (81.7, 71.3 and 57.8%), keeping the sanitation (71.7, 60 and 77.3%) and treatment of sick birds (58.3, 76.7 and 85.3%) as well as decision making for selling and buying (85, 81.1 and 81.3%) in lowland, midland and highland agro ecology respectively that agreed with the different findings stated as men were mainly responsible for shelter construction and /or partition (preparations of roosting materials) and women's for several activities like cleaning chicken house or shelter, provision of feeds and selling of chickens and eggs in different agro ecology [29, 17, 30, 10, 15, 27]. This indicated women play an important role in indigenous chicken production and management practices in the rural area of Eastern Ethiopia followed by children like other developing countries [31].

In the Eastern part of the country, the majority of the respondents (98%) were stored eggs for the marketing and incubation with less experience for home consumption except for house hold of better economic status and during the festivity in a year in the three agro ecology. The egg storage materials was varies depending on the availability in different area. The most widely used storage materials in low land, midland and highland were plastic (28.8%), basket made of bamboo (28.4% and 34.1%) followed by basket (25.4%) and pot made of clay or cow dung (23.9% and 23.8%) along with coffee hulls or dried grass as bedding materials respectively. This is supported by the finding of some result who stated that carton (20%), basket (41.8%), and clay pot (34.2%) were the most common storage materials in different agro ecology [32] and residues of Tef (*Eragrostis tef*) wheat and barley straws were used as bedding materials in different agro-ecological zones of Ethiopia [33].

Most of the respondents were used home laid egg for incubation in lowland (75.9%), midland (76.9%) and highland (73.9%) followed by purchased known eggs from neighbor after testing its quality by shaking and sun candling in lowland (53.8%) and midland (46.7%) and sun candling in highland (54.4%) area like the respondent of Metekel household who incubate eggs laid at home [34]. Those eggs were stored for more than nine days (44.7%) before setting. Agro ecologically, about 48.2%, 43.1% and 44% of the respondent stored egg for the average of duration of about 12 days with the range of 9 to 16days in low, mid and highland respectively until the required number of egg was produced for incubation which was similar with the finding of [35] who stated that the overall average pre-incubation storage duration was 12 days with ranges of 4 to 20 days in East Wollega. Almost the entire respondent used broody hen for incubation and the practices of artificial incubation is not performed even in the area where there is electric power supply as the report of other findings were also indicated [26, 36].

Before incubating the egg, more than 74% of the respondents were select the egg in the study area based on shape, size, storage age and color. The most common criteria used for selection were based on size of egg in lowland

(44.9%) and both the color and size in mid (45.7%) and highlands (54.4%). The size and color of eggs selected was large size and white color egg in low land (53.7%), midland (60%) and highland (59.5%) that in line with the result obtained at Woliyita zone and North Wollo who practice selection of eggs for incubation based on size, shape and color [26, 37] respectively. But, most of the respondent (60.5%) was not experienced to treat eggs before incubation. This is high in low land (75.9%) followed by midland (63.1%) while respondent in highland had better experience in hatching egg treatment than the two may be due to better exposure to extension service as a result office proximity. The common treatment used was washing with cold water and cleaning with dry cloth where treating with dry cloth (70%) was more practiced which was high in mid (66.7%) and highland (74.6). this result is comparable with 59% of the respondent practiced treating or rubbing the eggs using dry cloth before incubation [26, 38, 39]. But, almost all respondents have never observed the position of eggs during incubation as well as storage that may be due to the farmers did not know the effect of egg position during incubation and storage on the hatchability [35].

The common type of materials used as hatching egg in the rural area of Eastern Ethiopia was pot made of clay and cow dung in lowland (61.1%), mid (40%) and highland (53%) area with grass in low and midland and grass and straw in highland as bedding materials depending on its availability that placed close to fireplace or in protected dark area. In contrast to this, bamboo basket, cartons and simply shallow depression in the ground are the common materials used as hatching egg set in different agro ecological zone of Ethiopia [26, 33]. The trend of changing bedding material was not commonly practiced.

More than 80% of the respondent of the current study select broody hen based on body size, broody behavior and previous hatching ability in all agro ecology. But, body size was the main criterion used for selection. The practice of selecting broody hen based on its size was high in highland (88.8%) followed by mid (73.8) and low in low land (66.7%) in decreasing rate as agro ecology change from highland to lowland. This finding is agreed with research conducted in North Wollo that stated as broody hen selection was based on body size and broodiness ability giving high priority for body size [16, 37]. But, it is in contrast to the finding of [26] that reported brooding hen for incubation were selected based on body size, broody character, hatching history and number of egg laid giving high priority for broody character followed by hatching history

Hatching of eggs were preferred during the dry season by the rural household in Eastern Ethiopia due to seasonal variability in hatchability (74.3%) according to the report of respondents in lowland (90.7%), midland (72.3%) and highland (68.7%) which is better hatchability during the dry season in lowland (93.9%), midland (70.2%) and highland (70.7%) [2] and less chicken mortality due to less disease and parasite infestation, less environmental stress and better feed resource availability as compared with rainy season. This is

in lined with the finding of some authors who revealed that the respondents used broody hens for hatching eggs and growing chick during the dry season where there is good feed resources, less disease risk and favorable environment for growing chick [40, 26, 41, 42, 10, 16, 43].

Newly hatched chicks were fed on water soaked Enjera and grain of maize and sorghum, depending on the availability and scavenging most of the time in a day and also provides water intermittently. Water soaked Enjera was the common feed sources in lowland (42.6%) and mid land (58%) while grind grain was the common in highland (53.7%) which is consistent with [42] who reported that 70% of the chicken owner provide in water soaked Enjera (local bread prepared from flour teffs (*Eragrostic* teff). But, during incubation, broody hen rely on scavenging house left over grain and supplementation was not practiced in the area like the period of egg laying.

The broody hen that was not used for incubation by the rural poultry producer practice different means of breaking broodiness; handing the birds downward and depriving from water and feed, disturbing the egg laying nest and moving to neighbors. But, the most common type was handing the birds in lowland (53.3%), midland (34.4%) and highland (23.3%) followed by disturbing the nest in lowland (25%) and highland (21.3%) and both disturbing the nest and hanging the birds is refuse to leave during disturbing the nest. In contrast to this, few authors indicated that the majority of the respondents were take broody hen to the neighbor to break broodiness [26, 36, 38].

5. Conclusion

The result of the current study concluded that, local chicken were reared; where women performed the major management; to generate income from the selling of eggs and chickens particularly in lowland due to low diversified source of income. The produced eggs were stored until marketing and incubation using locally available materials of plastic, basket made of bamboo and pot made of clay or cow dung along with coffee hulls and/or dried grass as bedding materials for a week in lowland and more than a week in mid and highland agro ecology. Most of the time rural poultry producers used white color and large size laid at home for incubation during the dry season as a result of less chicken mortality due to less disease and parasite infestation, environmental stress and better-feed resource availability than rainy season.

The common facilities used as hatching egg setting materials in was pot made of clay and cow dung with dried grass in low and midland and dried grass and straw in highland as bedding materials depending on its availability that placed close to fireplace or in protected dark area. Broody hen used for incubation was selected based on body size particularly in highland and low in lowland. During incubation period, broody hens rely mainly on scavenging house left over grain and supplementation was not practiced in the area. But, newly hatched chickens were feed on water

soaked “Enjera” in lowland and midland and almost both grain and water soaked Enjera in highland. If farmers did not use broody hen for hatching, broodiness was interrupted by handing the bird down low, mid and highland followed by disturbing the nest in low and highlands and both disturbing the nest and hanging the birds is refuse to leave during disturbing the nest to resume laying.

6. Recommendation

The result of the study indicated that, there are a number of egg storage methods depending on the availability of materials, egg storage duration and handling of eggs that influence the quality of eggs before incubation as well as utilization. So, further investigation is required to evaluate and recommend the best methods of storage material and duration across different agro ecology and as most of poultry management is performed by women, provision of successful training on modern egg storage, incubation and the effect of egg storage on the quality of egg and hatchability is essential for improvement of poultry production.

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