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Original Research

## Hatching Egg Handling, Hatchery Management, and Chick Brooding Practices in Horo Buluk District, Horo Guduru Wollega Zone, Ethiopia

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### Abstract

Poultry production significantly contributes to farmers' livelihood in Ethiopia, particularly in rural areas such as the Horo Buluk District. However, challenges in hatching egg handling, hatchery management, and chick brooding practices often limit productivity. A cross-sectional survey using semi-structured questionnaires, focus group discussions, and field observations was employed with 130 respondents. Data were analyzed using descriptive statistics and chi-square tests. Women comprised 69.25% of respondents were primarily responsible for feeding and watering (64%), cleaning (64%), treating sick birds (48%), and making selling decisions (75%). Farmers store eggs using local materials including plastic, cartoon, clay pots, and straw. Seventy-five percent of eggs from local breeds were stored for more than nine days before incubation, exceeding the recommended maximum of seven days. Respondents incubated an average of 13 eggs (range 9–20) per broody hen. The most common selection methods were shaking the egg (59%) and sun candling (32%). The preferred hatching seasons were December to March (76%). Disease was the major health constraint (86.1%), where Newcastle (56%) was among the frequently occurring. A significant difference ( $p < 0.05$ ) existed between midland and highland areas regarding egg storage practices. Key constraints include prolonged egg storage, poor fertility testing methods, low vaccination coverage, and high first-week chick mortality. Women are the primary poultry managers, indicating that interventions must target women and accommodate their time constraints. The study recommends training on proper egg storage ( $\leq 7$  days), promotion of low-cost candling tools, seasonal Newcastle disease vaccination campaigns, and introduction of improved brooding technologies

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## INTRODUCTION

Poultry production has important economic, social, and cultural benefits and plays a significant role in family nutrition. It is estimated that the contribution of chicken production to global animal protein will rise to 40%, with the developing world experiencing the largest increase (Wong *et al.*, 2017). Approximately 80% of the poultry population in Africa is raised in traditional scavenging systems (Guteta, 2017). Poultry production is common in Ethiopia, where the national poultry population is estimated at 41.35 million. Most poultry are laying hens (39.24%) and chicks (28.51%), with breed compositions of 78.04% indigenous, 17.58% hybrid, and 4.34% exotic (CSA, 2022).

The majority (98%) of those chickens are maintained under a traditional system with little or no input for feeding (Mushi *et al.*, 2005). The common chicken production system in Ethiopia is free-range/scavenging type, using a majority (95.8%) of local chicken ecotypes, with only seasonal feed supplementation, scavenging only

(2.5%), scavenging with regular feed supplementation (21.9%), and intensive production system (0.63%) (Moges, 2009; Alemayehu *et al.*, 2015). Management and feed supplementation were provided based on chicken breed type, input and output level, mortality rate, type of producer, purpose of production, length of broodiness, growth rate, and number of chickens reared.

In order to guarantee the best hatchability rates and chick quality, hatchery management and chicken egg incubation are crucial components of the poultry industry that demand close attention (Ayalew *et al.*, 2023). The practice of keeping eggs at a particular temperature and humidity level, either naturally or artificially, to induce development and hatching of the embryo, along with all tasks related to handling, storing, incubating, hatching, and raising chicks, is included in hatchery management (Saeed *et al.*, 2019). Adame & Ameha (2023) found that a number of factors, including incubation method, hatchery requirements and management, incubation

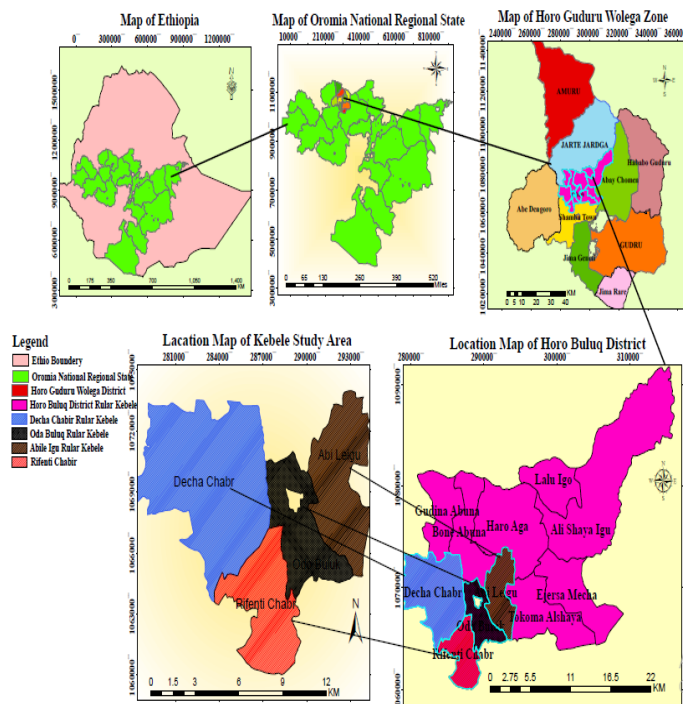
environment, and hatchery building architecture, affect how well eggs are incubated and hatched.

In Ethiopia, most farmers have always used broody hens to incubate eggs and rear chicks (Meseret, 2010; Addisu et al., 2013). Hence, indigenous knowledge of egg selection, storage, incubation, fertility testing, and hatchability constraints is essential for identifying interventions to improve chicken egg hatchability and serve as baseline data for sustainable chicken improvement programs. Therefore, the objective of this study was to assess and identify hatching egg handling, hatchery management, and chick brooding practices of farmers in the study area.

**MATERIALS AND METHODS**

**Description of the Study Area**

The study was conducted in Horo Buluk District (Figure 1), Horo Guduru Wollega Zone, Oromia, Ethiopia, located 331 km North-West of Addis Ababa. It is located at altitudes of 2200–3100 m (highland) and 1500–2500 m (midland) at 9°34' N latitude and 37°06' E longitude. Annual rainfall ranges from 1500 mm and 2000 mm (Land Management Administration Office of Horo Buluk District, 2023).



**Figure 1.**Map of Study Area

**Sampling Procedure and Sample Size Determination**

Horo Buluk District has 11 administrative kebeles. Four kebeles were purposively selected to represent different agroecological settings based on chicken population density, presence of traditional healers or knowledgeable persons, recommendations from elders and local authorities, altitudinal range, and resource availability. The selected kebeles were Oda Buluk, Dacha Chabir, Rifenti Chabir, and Abile Igu, comprising 412, 615, 570, and 630 households, respectively (the total 2227 households).

The sample size was determined using the standard formula for cross-sectional surveys with finite population correction (Daniel, 2009):

$$n = \frac{Nz^2pq}{E^2(N - 1) + z^2pq}$$

where *n* is the sample size, *N* = 2227 is the population size, *z* = 1.96 corresponds to the 95% confidence level, *p* = 0.10 is the estimated proportion, *q* = 1 - *p*, and *E* = 0.05 is the margin of error. The computed sample size was 130 households.

Initial sample size (*n*) = 138

Using finite population correction:  $nf = n / (1 + n/N) = 138 / (1 + 138/2227) = 130$

Systematic random sampling was applied with a sampling interval of *k* = *N*/*n* ≈ 17. The first household was selected randomly, followed by every 17th household thereafter. Additionally, seven key informants were selected purposively. The final sample comprised 90 females and 40 males aged above 12 years. For minors, assent was obtained from both the child and a parent or guardian. Key informants (traditional healers, knowledgeable farmers and elders) were selected with assistance from local elders, agricultural office workers, and administrative personnel.

**Data Sources**

Both primary and secondary data sources were used. Primary sources included development agents and indigenous community members. Secondary sources included the farmer training center journals, articles, and internet resources.

Data were collected from March to June 2023 during several field trips through: Semi-structured questionnaires (in Afaan Oromo) with both closed-ended and open-ended questions. The questionnaire was developed in English, translated into Afaan Oromo. It was piloted with 15 non-sample households, and adjustments were made for clarity. Enumerators (development agents) received one day of training on interview techniques, ethical conduct, and data recording. Focus group discussions (one per kebele) including development agents, animal health technicians, female affairs heads, elders, and experienced farmers. Direct field observations were also employed.

**Data Analysis**

Data were entered into Microsoft Excel (2010) and analyzed using SPSS version 20. Descriptive statistics (frequencies, percentages, means, standard deviations, ranges) were computed. For mean comparisons between agro-ecological zones (midland vs. highland), chi-square tests were used for categorical variables and independent t-tests for continuous variables. Statistical significance was set at *p* < 0.05. Effect sizes (Cramér's *V* for chi-square; Cohen's *d* for t-tests) and 95% confidence intervals for key proportions were calculated. No missing data were present due to supervised questionnaire completion. Clustering by kebele was not formally modeled due to the small number of clusters.

**RESULTS**

**Socio-Economic Characteristics of Respondents**

Women comprised 69.25% of respondents and men 31.8% (Table 1), confirming women's substantial involvement in chicken rearing and decision-making. This was attributed to men's focus on crop production. Regarding education, 30.8% completed grades 5–8, 35.4% completed grades 1–4, 14.6% were illiterate, 6% completed grades 9–12, and 13.1. had education beyond grade 12.

**Table 1.** Sex and educational status of respondents

Parameter	Category	Midland (n=64) n (%)	Highland (n=66) n (%)	Overall (N=130) n (%)	95% CI for overall %
Sex	Female	44 (68.75)	46 (69.75)	90 (69.25)	60.8–76.9
	Male	20 (31.2)	20 (30.3)	40 (30.8)	23.1–39.2
Education	Grades 5–8	18 (28.1)	22 (33.3)	40 (30.8)	23.1–39.2
	Grades 1–4	24 (37.5)	22 (33.3)	46 (35.4)	27.3–44.1
	Illiterate	10 (15.6)	9 (13.6)	19 (14.6)	9.1–21.8
	Grades 9–12	4 (6.3)	4 (6.1)	8 (6.2)	2.7–11.8
	Above grade 12	8 (12.5)	9 (13.6)	17 (13.1)	7.9–20.1

**Family Roles in Chicken Management**

Men were primarily responsible for house construction (28%), while women dominated feeding and watering (63.8%), cleaning (64%),

treating sick birds (47.7%), and make selling decisions (57.7%). (Table 2) Seventy-five percent of respondents used chicken for income food, children's tuition, and household expenses.

**Table 2.** Family roles in chicken rearing (select key roles)

Parameter	Category	Midland (n=64) n (%)	Highland (n=66) n (%)	Overall (N=130) n (%)
Feeding and watering	Women	40 (62.5)	43 (65.2)	83 (63.8)
Construction of house	Men	20 (31)	16 (24)	36(28)
Treating sick birds	Women	32 (50.0)	30 (45.5)	62 (47.7)
Cleaning	Women	32(50)	49(74)	81(64)
Selling decisions	Women	40 (62.5)	35 (53.0)	75 (57.7)

**Egg Storage and Handling**

Ninety-six percent of respondents stored eggs. The primary purposes were incubation (61.5%) and marketing (22%) (Table 3). Storage materials included cartons (32%), plastic (25%), pots (23%), and straw

(12%). A significant difference existed between midland and highland areas ( $\chi^2 = 6.84$ ,  $df = 2$ ,  $p = 0.033$ , Cramér's  $V = 0.23$ ) in egg storage and handling.

**Table 3.** Purpose of egg storage

Purpose	Midland (n=64) n (%)	Highland (n=66) n (%)	Overall (N=130) n (%)	95% CI
Incubation only	38 (59.4)	42 (63.6)	80 (61.5)	52.7–69.9
Marketing only	15 (23.4)	13 (19.7)	28 (21.5)	14.9–29.4
Both	11 (17.2)	11 (16.7)	22 (16.9)	10.9–24.4
<b>Storage Materials</b>				
Pot	15(23)	15(23)	30 (23)	15.3-32.5
Plastic	16(25)	16(24)	32(25)	18-31.2
Cartoon	21(33)	21(32)	42(32)	42-56.3
Straw	8(13)	8(12)	16(12)	8-18.5

**Egg Source, Storage Length, and Selection methods**

All respondents (100%) used home-produced eggs for incubation. Seventy-five percent of the respondents stored eggs for 9–16 days

before setting for brooding (Table 4). Selection methods included shaking (59%), sun candling (32%), floating (7%), and frying (2%). Shaking combined with sun candling was the most common combination (62%).

**Table 4.** Length of egg storage before incubation

Storage length	Midland (n=64) n (%)	Highland (n=66) n (%)	Overall (N=130) n (%)	95% CI	$\chi^2$	P-value
1–8 days	12 (18.8)	4 (6.1)	16 (12.3)	7.2–19.1	4.21	0.122
9–16 days	46 (71.9)	52 (78.8)	98 (75.4)	67.1–82.5		
>17 days	6 (9.4)	10 (15.2)	16 (12.3)	7.2–19.1		
<b>Selection methods</b>						
Sun candling	10(16)	7(11)	17(13)	8.1-20.5		
Shaking	9(14)	10(15)	19(15)	11.5-22.3		
Floating	7(11)	6(9)	13(10)	6.5-18.2		

**Number of Eggs and Chick Rearing**

Mean number of eggs set per broody hen was 13.1 (SD = 2.4, range 9–20). All respondents (100%) used natural brooding. Seventy-two

percent reported the highest chick mortality during the first week of life (Table 5)

**Table 5.** Chick mortality timing

Mortality period	Midland (n=64) n (%)	Highland (n=66) n (%)	Overall (N=130) n (%)	$\chi^2$	p-value
First week	42 (65.6)	51 (77.3)	93 (72)	5.21	0.022
Second week	9 (14.1)	12 (18.2)	21 (16.2)		
One month	13 (20.3)	3 (4.5)	16 (12.3)		
<b>Number of eggs</b>					
6-8	12(9)	8(12)	20(15)		
9-20	52(81)	58(88)	110(84.5)		
<b>Chick rearing methods</b>					
Broody hen	64(100)	66(100)	130(100)		

**Preferred Incubation Season**

The dry season (December–March) was preferred by 76.2% of

respondents (Table 6). The rainy season was considered the worst (76%) for hatchability due to insufficient warming, feeding scarcity, and disease.

**Table 6.** Preferred incubation season and hatchability failure

Season	Midland (n=64)	Highland (n=66)	Overall (N=130)	95% CI
	n (%)	n (%)	n (%)	
Dry (Dec–Mar)	46 (71.9)	53 (80.3)	99 (76.2)	68.0–83.2
Year-round	18 (28.1)	13 (19.7)	31 (23.8)	16.8–32.0
Hatchability failure				
Rainy season	53(80)	46(72)	99(76)	67.9-80.5
Handling cause	56(85)	42(66)	98(75)	66.6-78.4
Broody hen problem	10(15.2)	22 (27.1)	32(25)	18.2-36.7

**Management and Major Chicken Constraints**

According to respondents, separate house (68.5) is available for poultry and disease (86.1%) Table 7; was a major chicken constraint.

Newcastle disease was the most common disease (56%), with outbreaks occurring during rainy seasons.

**Table 7.** Housing and Health care managements

Major constraints	Agro-ecology		
	Midland (n=64)	Highland (n=66)	Overall (N=130)
	n (%)	n (%)	n (%)
Separate house	41(64)	48(73)	89(68.5)
No house	23(36)	18(27)	41(37.5)
Diseases	55 (87)	57(86)	112(86.1)
Predators	5 (8)	5(8)	10 (8)
Lack of feed resource	4(5)	5(5.9)	9 (5.9)
Newcastle disease	35(54)	37(56)	72(56)
Fowl cholera	14(22)	14(22)	28(22)
Fowl typhoid	8(12)	8(12)	16(12)
Coccidiosis	6(10)	8(10)	14(10)

**DISCUSSION**

This study documents traditional hatching and brooding practices in a resource-constrained Ethiopian district. The findings are consistent with prior Ethiopian studies highlighting critical intervention gaps. Women's dominance (69%) in poultry management practices was supported with Tadesse (2016) who reported the highest the highest women (82.5%) role in poultry production in East Hararghe despite the proportion in current study is lower compared to his findings. This has implications for extension design: interventions must target women and accommodate their time constraints.

Regarding respondents' educational background, 40.25% had completed grades 5–8, while 35% had completed grades 1–4 indicating that most respondents in the study area had at least some primary education.

The current study strongly showed that women's involvement in cleaning (64%), treating sick birds (48%), and selling decisions (75%) was higher compared to men and children. Concerning expenses, 75% of respondents said they utilized the income to pay for food purchases, their children's tuition, and other household expenses, making the selling of both eggs and live chickens their top priority.

Local chicken production in the study area is largely limited to upper socioeconomic households and occurs mainly during annual celebrations, where children are prioritized over household heads, rather than for regular domestic use. The majority of egg storage materials used prior to incubation included plastic, cartoon, clay/dung pots, or straw, depending on availability. Carton usage accounted for 32% of storage materials, followed by plastic (25%) and pots (23%), with grain straw (12%). These findings align with Deneke (2013), who reported common egg storage materials such as clay pots, bamboo baskets, cartons, or shallow ground dips.

A significant difference existed between midland and highland areas regarding the purpose and type of egg storage materials. The present result is in line with the report of Desta & Wakeyo (2024) that eggs deposited at home and used for incubation were kept in storage for more than nine days before brooding. According to the agro-ecological analysis, households kept eggs in mid- and highland areas for about a week until the necessary quantity was reached for incubation. All respondents utilized broody hens for incubation, and artificial incubation techniques was not found even in areas with access to electricity.

The mean number of eggs set per broody hen was 13 (range 9–18), consistent with Dessie and Ogle (2001) (13±2.2 eggs) and Habte *et al.* (2013) (10.2–11.3 eggs). According to Habte *et al.* (2013), the number of eggs is determined by the hen's size and maternal instinct. Mamo *et al.* (2011) and Sonaiya & Swan (2004) reported similar findings, indicating that farmers used dry materials (cloth) to treat (rub) favoured eggs before incubation. Dereje (2001), in contrast, reported that farmers treat eggs before incubation by soaking them in cloth.

The methods for selecting fresh (normal) eggs included floating on water, shaking the egg, sun candling, and frying an egg sample. The two most popular techniques were shaking the egg (59%) and sun candling (32%). This outcome is consistent with Matiwas *et al.* (2013), who found that households can distinguish between normal and rotten eggs by shaking them (47.8%). Mamo *et al.* (2011) found, in contrast, that 61% of households in South Wollo could tell normal eggs from rotten ones only by visual inspection.

Freshness (normal) eggs checked relied on shaking (59%) and sun candling (32%), consistent with Matiwas *et al.* (2013) who reported (47.8%) for shaking. However, these methods have low sensitivity (shaking may damage eggs; sun candling requires clear skies and

skill). Training on low-cost candles (LED flashlights) could improve accuracy and reduce egg wastage. All respondents (100%) used natural brooding, matching Shishay *et al.* (2014) in western Ethiopia. The broody hen (75%), with the help of a dedicated chick brooder (25%), was mostly in charge of raising chicks when they hatched. This result is consistent with Solomon *et al.* (2013), who stated that chicks are produced and nurtured naturally throughout rural Ethiopia through incubation and brooding. Farmers also stated that lack of brooding hens, vaccination gaps, and predators were the primary causes of reduced chick survival.

Feeding and watering practices was common with no significant difference in agro-ecological zones. However, 72% of respondents reported the highest chick mortality during the first week of age, which is higher than the 53.8% reported by Etalem (2019) in Gamo Gofa Zone. The mortality might be related with poor management, lack of vaccination and improper feeding. Respondents strongly preferred the dry season (December to March) for incubation (76%) as also Ermias (2015) noted that thunderstorm sounds may cause eggs to rot and chicks to die from fear. Similarly, Dessie and Ogle (2001) reported that farmers in the central highlands avoid setting eggs before the rainy season (mid-June to mid-September) due to cold weather spoilage. In Western Tigray, June to February were preferred for incubation, while March to May were worst (Markos *et al.*, 2014).

The seasonal preference for dry-season hatching (76%) aligns with Markos *et al.* (2014) in Tigray and with Kitalyi (1998). Farmers correctly identified improved feed availability, lower predator pressure, and reduced disease risk. Rainy-season hatching constraints (cold, wet conditions, thunderstorm-induced hen stress) are plausible and locally validated. Consistent with Kitalyi (1998), incubation season significantly affects hatchability, suggesting that seasonal variation in local broody hen performance is linked to time of year.

In this study, 68.5% of respondents had a separate chicken house, while 31.5% did not. The main reasons for not constructing a house were lack of professional advice, high material costs, and workload. According to Halima (2007), Northwest Amhara farmers provided separate sheds for their chickens. In contrary to this findings Leta & Bekana (2010) reported lowest percentage of village chickens provided separate house. Other side of the world (Mandal *et al.*, 2006) reported India (97.5%), and Muchadeyi (*et al.*, 2005) showed Zimbabwe (82%) were providing separate house. The report indicates that still housing village chickens in Ethiopia need immense attention.

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Disease was the major challenge, with 86.1% of respondents reporting chicken losses due to this factor. Newcastle disease (56%) was the major outbreaks during rainy seasons (January–April and August–October) as report of the study area animal health center data. This finding is consistent with Selam & Kelay (2013) and Leta & Bekana (2010), who reported that Newcastle disease occurs seasonally and is the major chicken-killing disease in different agro-ecologies of Ethiopia.

## CONCLUSION

Farmers in Horo Buluk District rely exclusively on natural incubation using broody hens, with women playing the dominant role in poultry management, including feeding, cleaning, treating sick birds, and make selling decisions. Key constraints limiting productivity include prolonged egg storage, which exceeds the recommended maximum of 7 days. Others factors are inefficient egg selection methods such as shaking and sun candling disease and high chick mortality during the first week of age. The preferred hatching season is the dry period (December to March) due to better feed availability, lower predation, and reduced disease risk. A significant difference ( $p < 0.05$ ) existed between midland and highland areas regarding egg storage materials and practices. Generally, it is recommendable to improve village poultry production, interventions must target women through training on proper egg storage, promotion of low-cost candling tools, seasonal Newcastle disease vaccination campaigns, and introduction of improved brooding technologies such as mini-hatcheries and hay box brooders.

## Competing Interests

The authors declare no competing interests.

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This study received no external funding.

## Data Availability

The datasets used and analyzed are available from the corresponding author upon reasonable request.

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