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Characterization of Village Chicken Production Systems in Three Agro-climatic Zones of Western Tigray, Northern, Ethiopia

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ABSTRACT

A survey was conducted in Tigray, Northern Ethiopia, to characterize village chicken production systems using a questionnaire and group discussions. Data was analyzed using SPSS 22. Respondents provided supplementary feeds to chickens to improve yields and health. Sorghum, maize, sesame, tomato, onion, barley, and household food leftovers were the main supplementary feeds, although the types of cereal crops produced varied across agro-climates. Harvest and purchase were main sources of cereal and non-cereal chicken feeds, respectively. 50.4% considered summer, 48.8% winter as critical feed seasons. Farmers provided feeds to their chickens in the morning (98.7%), afternoon (69.6%), and evening (81.3%), and on the ground for collective feeding (97.9%). 59.5% of respondents constructed separate chicken houses, with 56.1% being permanent structures and 3.4% temporary. Chicken houses were constructed using materials such as mud, wood, iron sheet roofing, bamboo, grass, and plastic. 57.7% cleaned chicken houses, 66% once daily, and 2.1% not at all. Water was provided ad libitum (70.9%), once a day (7.5%), or twice a day (21.6%) from wells, taps, or rivers using various waterers. Eighty-six percent of the respondents cleaned chicken waterers, while the remaining 14% did not. Training is needed for house construction, feeding, watering, cleaning, and disinfection of feeders and waterers to prevent waterborne diseases.

INTRODUCTION

Village chicken production plays a vital role in capital accumulation and reducing poverty, malnutrition, and hunger among resource-poor households in developing countries (Besbes, 2009). Lawal *et al.* (2016) state that the reason for this is that raising this livestock species necessitates a lesser amount of investment when compared to other livestock species.

Poultry production is widely practiced by smallholder farmers in Ethiopia (Fisseha *et al.*, 2010). Village poultry are valuable assets for smallholder farmers in Africa, contributing to food security, poverty alleviation, and gender equality, particularly among marginalized groups (RSHD, 2011). Additionally, village chicken production provides employment opportunities for rural smallholders and offers socio-cultural benefits (Moges *et al.*, 2010), while also playing a crucial role in ensuring household food security and generating income. Chickens are often referred to as the "poor man's bank," symbolizing the value they hold as an investment (Shishay *et al.*, 2014).

Ethiopia's population is estimated to be 59.5 million, with indigenous non-descriptive breed chickens accounting for 90.85%, hybrid chickens for 4.76%, and exotic breeds for 4.39% (CSA, 2018). The majorities, 99%, of these chickens are raised in traditional backyard systems, while 1% is managed intensively (Tadelle *et al.*, 2003; Ashenafi and Eshetu, 2004). According to Tadelle (2003) and Mekonnen *et al.* (2010), the production of village chickens accounts for more than 95% of poultry production in the country. In Ethiopia, village chicken production contributes 90% to national egg production and 92% to poultry meat production (CSA, 2018; Tadelle, 2003). However, their impact on farm households and rural economies is disproportionate due to poor management systems and other constraints.

Despite the crucial role of local chickens for smallholder farmers, there has been limited effort to investigate and characterize their production systems for genetic and phenotypic improvement. Characterizing village chicken production systems in various agro-climatic zones can help identify intervention points and design agro-ecology-specific policies, research strategies, and breeding programs for sustainable and improved chicken production. Previous studies on the characterization of chicken production systems have been conducted in different rural areas of Ethiopia (Tadelle *et al.*, 2003; Worku *et al.*, 2012; Nebiyu *et al.*, 2013; Aman *et al.*, 2015; Letebrhan *et al.*, 2015; Goraga *et al.*, 2016; Haile & Biratu, 2017; Asmelash *et al.*, 2018; Hailu *et al.*, 2019; Meskerem *et al.*, 2019; Assefa & Ewuneta, 2020) and in the urban area of Ethiopia (Wondu *et al.*, 2013). However, there is limited information on the characterization of village chicken production in the three agro-climatic zones of western Tigray. This study aims to fill that gap by characterizing village chicken production systems in the western zone of Tigray.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in rural districts of Kafta Humera, Welkait, and Tsegede in the Western Zone of Tigray Regional State, Ethiopia. These districts have a

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total of 81 peasant associations, with 77 rural and four urban associations. The zone covers 1.5 million hectares, with varying land distribution across the districts (HUARC, 2013). Out of the total land, 573,285 hectares are cultivated, while 927,000 hectares remain uncultivated. The zone is divided into Kolla, Weyna dega, and Dega agro-climatic zones.

The zone is situated between 13°42' to 14°28' north latitude and 36°23' to 37°31' east longitude (Mekonnen *et al*., 2011). It experiences annual rainfall ranging from 600 mm to 1800 mm, with temperatures varying from 27°C to 45°C in the kolla, 15°C to 30°C in the Weynadega, and 10°C to 22°C in the dega. The altitude ranges from 500 to 3008 m.a.s.l. It shares borders with Tahtay Adibayo, Tselemti, and Asgede Tsimbla in the east, Sudan in the west, the Amhara region in the south, and Eritrea in the north. The study area represents a remote, tropical climate where extensive agriculture is predominantly carried out manually by migrant laborers.

Sampling Techniques

Three rural districts (Welkait, Tsegede, and Kafta Humera) were purposefully chosen for the study. In Welkait and Tsegede, peasant associations were categorized into Kolla, Weyna dega, and Dega agro-climatic zones. However, in Kafta Humera, only Weyna dega and Kolla areas were considered. The selection criteria included village poultry population density, chicken production potential, and road accessibility. Four peasant associations were selected from the Kolla zone, three from the Weyna dega zone, and two from the Dega zone. A total of 385 farmers were chosen using purposive random sampling, based on their registration in the household package beneficiary's book in each peasant association. The number of respondents per peasant association was determined proportionately, considering the size of households in the sample areas.

Sample Size Determination

The total required number of respondents was determined using the Cochran formula for an infinite population (population size ≥ 50,000) (Cochran, 1963). The formula is as follows: $No = Z^2pq/e^2$, where No represents the required sample size. Z^2 is the abscissa of the normal curve that cuts off an area at the tails (1-α) (for a 95% confidence level, Z = 1.96). e is the margin of error (e.g., ±0.05% margin of error for a 95% confidence level). P refers to the degree of variability in the attributes being measured, specifically the distribution of attributes in the population.

q = 1 - p.

$No = Z^2pq/e^2 = [(1.96)^2 \times (0.5) \times (0.5)] / (0.05 \times 0.05) = [3.8416 \times 0.25] / (0.0025) = 0.9604 / 0.0025 = 385$ farmers.

The number of respondents per single selected peasant association was determined using the proportionate sampling technique (Shishay *et al*., 2014) as follows: W = [A/B] x No, where A represents the total number of households living in a single selected peasant association, B represents the total sum of households living in all selected peasant associations, and No is the total required calculated sample size.

Data Collection

Data on household characteristics, farming systems, grazing patterns, main cereal crops, and chicken husbandry practices were gathered through individual interviews using a tested questionnaire. Additionally, one group discussion was conducted for each agro-climatic zone, with 10-12 participants per group.

$$No = \frac{Z^2pq}{e^2}$$

Statistical Analysis

The survey data were analyzed using descriptive statistics and cross-tabulation in SPSS version 22 (SPSS, 2013). The Kruskal-Wallis Test, a non-parametric test option in SPSS, was used to test the effect of agro-ecology on the proportion of each qualitative survey.

The main crops produced, advantages, and problems in separate poultry house construction were identified and ranked across the three agro-climatic zones during individual interviews using a ranking index (Kosegey, 2004).

RESULT AND DISCUSSION

Overall Production Description

The study showed that 97.7% of respondents practiced mixed farming, while 2.1% and 0.3% were involved in sole livestock and sole crop production, respectively, in the study area (Table 1). Farming strategies were evenly distributed across all agro-climatic zones. This finding is consistent with Azanaw's (2017) research in Tsegede district, where mixed crop-livestock production was the main farming system (90%). In terms of grazing patterns, the survey found that mixed grazing (97.1%) was the most common, while zero grazing (0.3%) was the least common in the research area.

The distribution of free, zero, and mixed grazing patterns was consistent across agro-climatic zones. However, only 0.6% of respondents in the Kolla practiced zero-grazing, and none of the respondents in the Dega and Weyna dega agro-climatic zones practiced this strategy.

Table 1: Overall production systems in three agro-climatic zones of western Tigray

Variables	Agro-climatic zones				X^2-test	p-value
	Dega (n=94)	Weyna dega (n=131)	Kolla (n=160)	Total (N=385)		
Farming System					**4.859(ns)**	**0.088**

Crop production	-	1(0.8)	--	1(0.3)		
Livestock production	4(4.3)	4(3.1)	-	8(2.1)		
Both production	90(95.7)		126(96.2)	160(100)	376(97.7)	126(96.2)
Grazing Pattern					**2.625(ns)**	**0.269**
Free grazing	4(4.3)	5(3.8)	1(0.6)	10(2.6)		
Zero grazing	-	-	1(0.6)	1(0.3)		
Mixed grazing	90(95.7)	126(96.2)	158(98.8)	374(97.1)		

The rankings of cereal crops varied across agro-climatic zones, indicating differences in proportions (Table 2). These differences could be attributed to variations in climatic suitability and agro-ecological variables such as rainfall, temperature, humidity, and soil fertility among the agro-climatic zones. In the Kolla agro-climate, the most economically important crops were maize, sorghum, and sesame. In the Weyna dega agro-climate, the top four crops were teff, finger millet, wheat, and barley. Similarly, in the Dega agro-climatic zone, the most economically significant cereal crops were finger millet, teff, barley, and wheat, in that order. This result is in agreement with the findings of Goraga *et al.* (2016), who reported that barley is the most dominant crop produced in the Kolla agro-climatic zone, followed by Teff in the second position and teff in the third position.

In the Weyna dega agro-climatic zone, teff is the most dominant crop, followed by wheat in the second position and barley in the third position. Similarly, in the Dega agro-climatic zone, barley is the most dominant crop, followed by wheat in the second position and maize in the third position.

Table 2: Ranking of main crops produced across the three agro-climatic zones of western Tigray

Main Crops Produced in Kolla agro-climate							
Crops	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Sesame	906	45	0	0	0	0	0.26
Sorghum	540	350	0	0	0	0	0.24
Maize	12	60	488	54	0	0	0.17
Bultug	0	0	80	390	20	0	0.13
Finger Millet	0	0	32	294	100	4	0.12
Rice	0	0	8	210	16	80	0.09

Weyna dega agro-climate											
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**Index**
Teff	900	180	168	0	0	0	0	0	0	0	0.1200
Finger Millet	880	180	184	0	0	0	0	0	0	0	0.1197
Wheat	820	252	168	0	0	0	0	0	0	0	0.1193
Barley	790	180	160	84	0	0	0	0	0	0	0.1168
Maize	720	162	80	63	66	55	0	0	0	0	0.1102
Fababeans	680	153	88	42	60	30	16	27	0	0	0.1054
Noug	600	117	72	84	42	50	32	36	0	0	0.0994
Lentils	490	180	72	77	24	30	24	6	12	20	0.0899
Chickpea	260	81	56	28	48	30	36	30	44	30	0.0619
Sorghum	160	72	96	63	48	35	12	45	26	40	0.0574

Dega agro-climate									
Crops	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**Index**
Wheat	630	96	56	24	0	0	0	0	0	0.132
Barley	558	80	49	60	25	0	0	0	0	0.126
Teff	450	72	56	72	45	24	0	0	0	0.118
Finger Millet	432	72	49	54	55	40	0	0	0	0.115
Maize	414	64	35	48	35	48	24	0	0	0.109
Fababeans	378	80	35	48	30	40	18	6	4	0.105
Lentils	360	128	49	12	20	24	21	8	8	0.103

Noug	324	112	63	30	35	24	9	10	9	0.101
Chickpea	234	144	42	24	35	36	18	16	10	0.091

Chicken Husbandry Practices

Feed Resources and Feeding

Table 3 displays the types of feed, feed resources, and feeding practices for chickens on a daily basis. All the farmers interviewed in the study provided supplementary feeds in addition to allowing the chickens to scavenge freely. This finding aligns with similar studies conducted by Worku *et al.* (2012) in the west Amhara region of Ethiopia (100%), Moges *et al.* (2010) in the Bure district of northwest Ethiopia (97.5%), Tadesse *et al.* (2013) in the Ada'a and Lume districts of East Shewa (97.8%), and Addisu *et al.* (2013) in the North Wollo zone of the Amhara regional state (89.87%). The current results also support the studies conducted by Letebrhan *et al.* (2015) in the Gantaafeshum district of Eastern Tigray (100%), Haile and Biratu (2017) in the Jimma and Ilu Aba Bora zones of southwest Ethiopia (100%), and Assefa and Ewuneta (2020) in the Mekel district of the North Wollo zone (94.2%). Similar results have also been reported in Cambodia, where 94.7%, 100%, 95.8%, 87.2%, and 97.7% of local chicken owners provided supplementary feeds in the Kampong Cham, Kampot, Odar Meanchey, Rattanakiri, and Siem Reap provinces (FAO, 2009). However, these findings contradict the results of Wondu *et al.* (2013), Asmelash *et al.* (2018), Hailu *et al.* (2019), and Meskerem *et al.* (2019), who reported that farmers predominantly relied on scavenging as the main chicken feeding practice with limited supplementation in North Gondar, Eastern Ethiopia, the Shaka zone, and the Dado district of the Jimma zone of Ethiopia, respectively.

Maize, sorghum, and sesame were the main supplementary feeds provided to chickens in the three agro-climatic zones. However, barley, wheat, and noug were only used as supplements in the Weyna dega and Dega agro-climatic zones. For young chicks, from the day they were born until they reached one month old, teff, finger millet, noug, and ground sorghum and maize were commonly given as these crops were easier for them to consume without any mechanical treatment. These findings are consistent with the research conducted by Tadesse *et al.* (2013), which revealed that local chicken owners in East Shewa, Ethiopia, used wheat, and maize (94.9%), kitchen waste (100%), wheat bran (1.7%), and limestone (2.2%) as supplementary feeds for their chickens. Similarly, Addisu *et al.* (2013) reported that sorghum (36.7%), wheat (36.27%), maize (25.53%), and a mixture (3.93%) were the primary feed resources used by local chicken owners in the North Wollo zone of the Amhara region. These current results are also supported by studies conducted in various parts of Ethiopia (Wondu *et al.*, 2013; Letebrhan *et al.*, 2015; Haile and Biratu, 2017; Asmelash *et al.*, 2018; Hailu *et al.*, 2019; Aman *et al.*, 2019; Meskerem *et al.*, 2019; Assefa and Ewuneta, 2020), where chicken owners used cereal grains and household food leftovers as supplementary feeds for chickens.

Supplementary feeds for chickens were obtained from both farm-produced and market-purchased sources. Cereal and non-cereal supplementary feeds were mainly harvested and purchased, respectively (as shown in Table 3). This finding is consistent with a study by Worku *et al.* (2012), which found that 87.2% of respondents in the West Amhara region of Ethiopia used supplementary feeds produced on their own farms, while 2.6% and 10.2% used purchased feeds and other sources, respectively. In Cambodia, households providing supplementary feeds for chickens relied on purchased feeds as sources, with percentages ranging from 4.5% to 35.2% in different provinces (FAO, 2009). Similar results were found in studies conducted in various areas of Ethiopia (Letebrhan *et al.*, 2015; Haile and Biratu, 2017; Meskerem *et al.*, 2019), where farmers primarily used farm-produced feeds and purchased feeds as secondary sources for chicken feed. These findings demonstrate that farmers use a variety of feed resources for chickens to ensure the sustainability of village-based chicken production and contribute to the community's income, nutritional status, and food security.

Table 3: Practice for supplementation, feed types and feed resources

Variables		**Agro-climatic zones**				**X^2-test**	**p-value**
		Dega n (%)	**Weyna dega n (%)**	**Kolla n (%)**	**Total n (%)**		
Supplementation over scavenging							
Yes		94(100)	131(100)	160(100)	385(100)	0.00(ns)	1.00
No		-	-	-	-		
Feed types	Feed Sources						
Maize	harvest	88(93.6)	126(96.2)	152(95)	366(95.1)		
	Donation/gift	6(6.4)	5(3.8)	5(3.1)	16(4.2)		
	Total	**94(100)**	**131(100)**	**157(98.1)**	**382(99.2)**	**1.567(ns)**	**0.457**
sorghum	Harvest	87(92.6)	126(96.2)	160(100)	373(96.9)		
	Purchase	7(7.4)	5(3.8)	-	12(3.1)		
	Total	**94(100)**	**131(100)**	**160(100)**	**385(100)**	**11.196(*)**	**0.004**

Sesame	Harvest	21(22.3)	89(67.9)	140(87.5)	250(64.9)		
	Purchase	-	1(0.8)	-	1(0.3)		
	Total	**21(22.3)**	**90(68.7)**	**140(87.5)**	**251(65.2)**	**1.796(ns)**	**0.407**
barley	Harvest	63(67)	50(38.1)	-	113(29.4)		
	Purchase	2(2.1)	1(0.8)	-	3(0.8)		
	Total	**65(69.1)**	**51(38.9)**	**-**	**116(30.1)**	**0.141(ns)**	**0.707**
Wheat	Harvest	19(20.2)	15(11.4)	-	34(8.8)		
	Purchase	-	1(0.8)	-	1(0.3)		
	Total	**19(20.2)**	**16(12.2)**	**-**	**35(9.1)**	**1.222(ns)**	**0.269**
Finger millet	Harvest	43(45.7)	38(29)	8(5)	89(23.1)		
	Purchase	-	-	1(0.6)	1(0.3)		
	Total	**43(45.7)**	**38(29)**	**9(5.6)**	**90(23.4)**	**9.101(*)**	**0.011**
Teff	Harvest	44(46.8)	50(38.2)	11(6.9)	105(27.3)		
	Purchase	-	3(2.3)	1(0.6)	4(1)		
	Total	**44(46.8)**	**53(40.5)**	**12(7.5)**	**109(28.3)**	**3.009(ns)**	**0.222**
Noug	Harvest	31(33)	51(38.9)	-	82(21.3)		
	Purchase	-	2(1.5)	-	2(0.5)		
	Total	**31(33)**	**53(40.5)**	**-**	**84(21.8)**	**1.198(ns)**	**0.274**
Tomato leftover	Harvest	3(3.2)	-	-	3(0.8)		
	Purchase	18(19.1)	36(27.5)	98(61.2)	152(39.5)		
	Total	**21(22.3)**	**36(27.5)**	**98(61.2)**	**155(40.3)**	**19.521(*)**	**0.000**
Onion leftover	Harvest	1(1.1)	-	-	1(0.3)		
	Purchase	18(19.1)	36(27.5)	99(61.9)	153(39.7)		
	Total	**19(20.2)**	**36(27.5)**	**99(61.9)**	**154(40)**	**7.152(*)**	**0.028**
Cabbage leftover	Harvest	1(1.1)	-	-	1(0.3)		
	Purchase	6(6.4)	30(22.9)	59(36.9)	95(24.7)		
	Total	**7(7.4)**	**30(22.9**	**59(36.9)**	**96(24.9)**	**12.848(*)**	**0.002**
Injera and bread leftover		94(100)	131(100)	160(100)	385(100)	0.0(ns)	0.005

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

In the research area, farmers predominantly practiced feed supplementation at various times of the day. The majority (58.4%) provided feed three times a day (morning, afternoon, and evening), while 20.5% offered feed twice a day (morning and evening), 9.9% provided feed twice a day (morning and afternoon), and 8.1% offered feed once a day (morning only) (as shown in Table 4). This finding aligns with a study by Tadesse *et al.* (2013), which found that 78.9% of local chicken owners in East Shewa, Ethiopia provided supplementary feeds three times a day, while 21.9% offered feeds twice a day. However, contrasting results were reported in the Jimma and Ilu Aba Bora Zones of South Western Ethiopia, where 33% of households provided supplementary feeds once a day, 55% offered feeds twice a day, and 12% provided feeds three times a day (Haile and Biratu, 2017). Letebrhan *et al.* (2015) reported that 55.6% of households provided supplementary feeds once a day, 40.6% offered feeds twice a day, and 3.8% provided feeds three times a day, which contradicts the current result.

These findings suggest that farmers' understanding of proper feed supplementation for chickens improves over time as they gain knowledge from their experiences and extension services. Therefore, it is crucial to encourage

Table 4: The schedule for providing supplementary feed to local chickens in the western zone of Tigray

Variables	Agro-climatic zones				X^2-test	P-value
	Dega n(%)	Weyna dega n(%)	Kolla n(%)	Total n(%)		
Feed supplementation Timing					**31.627(*)**	**0.005**
Morning	12(12.8)	5(3.8)	14(8.8)	31(8.1)		
Morning ,afternoon and evening	48(51.1)	71(54.2)	106(66.2)	225(58.4)		

Morning and afternoon	12(12.8)	11(8.4)	15(9.4)	38(9.9)		
Morning and evening	16(17)	41(31.3)	22(13.8)	79(20.5)		
More than three times /day	1(1.1)	2(1.5)	2(1.2)	5(1.3)		
Morning &evening in dry season ,& morning, afternoon and evening in rainy season	3(3.2)	1(0.8)	-	4(1)		
Chicks &brooding hen receive supplements in morning & evening while the rest receive in morning only	1(1.1)	-	1(0.6)	2(0.5)		
Chicks offer three times /day, while the rest offer two times /day	1(1.1)	-	-	1(0.3)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

local chicken producers to provide diverse supplementary feed resources to chickens based on their age and production levels. This approach will ensure sustainable and improved chicken production, leading to food security for farmers and reducing the risk of childhood illnesses through the diversification of consumable foods. The results indicated that the majority of participants (98.7%) gave supplementary feeds to their chickens once in the morning, while a small proportion (1.3%) offered feed twice in the morning (Table 5). In the afternoon and evening, 30.1% and 18.4% of households, respectively, did not provide additional feed to chickens. However, most households (69.6% in the afternoon and 81.35% in the evening) only provided supplementary feed to chicks once a day. A very small percentage (0.3%) supplied feed twice in the afternoon and evening. These findings contrast with the study by Wondu *et al.* (2013), which reported lower percentages of households providing feed once in the morning, afternoon, and evening in Northern Gondar of the Amhara regional state of Ethiopia.

The findings revealed that 94.8% of the respondents provided supplementary feeds for all classes of chickens collectively. Additionally, 3.1% offered feeds separately for different age groups to prevent competition, while 2.1% provided feeds to layers along with their chicks. Regarding feeding methods, 2.1% used local containers, and 97.8% fed chickens on the ground for communal feeding. These findings are somewhat consistent with the study by Meskerem *et al.* (2019), which indicated that 55.6% of respondents offered feeds for different age groups together and 44.4% provided separate feeds in the Dedo district of the Jimma zone in Ethiopia . The same study also found that 82.4% fed chickens on the ground, 9.4% used local feeders, and 7.8% used both local feeders and ground for feeding chickens. Both the current study and previous findings suggest that farmers commonly provide supplementary feeds on the ground for collective feeding, regardless of chicken age or production level. However, it is important to note that group feeding can lead to competition and cannibalism, as dominant chickens may prevent others from accessing feed and water. To prevent such issues and maximize productivity, farmers are strongly advised to provide a well-balanced diet and ample water separately based on age categories and production levels. This approach will help prevent cannibalism, which has been associated with deficiencies in protein, sodium, and phosphorus (Sheila and Sara, 2007).

Table 5: Feeding frequency, feed provision, and methods of providing supplementary feed for chickens

Variables	**Agro-climatic zones**				**X^2-test**	**p-value**
	Dega n(%)	**Weyna dega n(%)**	**Kolla n(%)**	**Total n(%)**		
Feeding frequency/day in morning					**0.097(ns)**	**0.953**
Once	93(98.9)	129(98.5)	158(98.8)	380(98.7)		
Twice	1(1.1)	2(1.5)	2(1.2)	5(1.3)		
Afternoon					**10.985(*)**	**0.027**
None	34(36.2)	47(35.9)	35(21.9)	116(30.1)		
Once	60(63.8)	83(63.4)	125(78.1)	268(69.6)		
Twice	-	1(0.8)	-	1(0.3)		
Evening					**9.340(ns)**	**0.053**
None	25(26.6)	16(12.2)	30(18.8)	71(18.4)		
Once	69(73.4)	114(87)	130(81.2)	313(81.3)		
Twice	-	1(0.8)	-	1(0.3)		
Feed provision					**7.256(*)**	**0.027**
Put feed in containers	-	1(0.8)	7(4.4)	8(2.1)		

Spread on ground for collective feeding	94(100)	130(99.2)	153(95.6)	377(97.9)		
Ways of supplementation					**29.666(*)**	**0.000**
Separate into different classes	-	-	12(7.5)	12(3.1)		
Feeding together as group	94(100)	131(100)	140(87.5)	365(94.8)		
Feeding chicks with their mother while providing separate feed for the rest	-	-	8(5)	8(2.1)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

The reasons for providing supplementary feeds varied significantly across different agro-ecologies (p<0.05) (Table 6). Generally, the main objectives of offering these feeds were to improve egg and meat production and maintain the health of the chickens (90.6%). A smaller proportion (6.2%) aimed to increase both meat and egg yields. A similar study conducted in the Meket district of North Wollo zone of the Amhara regional state reported that chicken owners primarily supplemented feeds to increase egg yield (74.3%), shorting broodiness (18.7%), meat yield (3.5%), and increase egg yield and shorting broodiness (3.5%) (Assefa and Ewuneta, 2020).

The study found significant differences in timing and perceived benefits of feed supplementation across various agro-climatic zones in the study area (Table 6). In the Kolla agro-climate, 63.1% of respondents cited the dry season as the critical period for supplemental feeding due to a lack of available feed for scavenging. Conversely, in the Weyna dega agro-climate, 61.8% reported the summer as the critical season for extra feeding, attributed to a shortage of grain supplements and household food leftovers. Regarding perceived improvements, only 1.9% of respondents in the Kolla agro-climate reported an increase in egg yield from feed supplementation, while none in the Weyna dega and Dega agro-climatic zones identified egg yield as the sole improvement. In the Dega agro-climate, 18.1% of households perceived improvements in both egg yield and growth, compared to the Kolla (2.5%) and Weyna dega (0%) agro-climates. Additionally, a higher percentage of respondents in the Weyna dega agro-climate (100%) perceived improvements in egg yield, growth, and health status due to feed supplementation, compared to the Kolla (95.6%) and Dega (81.9%) agro-climates.

Furthermore, 93.8% of respondents perceived improvements in egg yield, growth, and health status resulting from feed supplementation, with 5.5% reporting improvements in both egg yield and growth, and 0.8% identifying sole improvements in egg yield. Overall, the study found that 50.1% of households identified summer as the critical season for extra feeding due to a shortage of grain supplements and household food leftovers, while 48.8% pointed to winter as the critical season due to a scarcity of feed for scavenging. Haile and Biratu (2017) found that October, December, and January have feed availability, while April, May, June, July, and August have chicken feed shortages in the Jimma and Ilu Aba Bora Zones of South Western Ethiopia.

Table 6: Reasons for providing supplementary feeds, perceived benefits from the additional supplements, and timing of extra feeding

Variables	Agro-climatic zones				X^2-test	p-value
	Dega n(%)	Weyna dega n(%)	Kolla n(%)	Total n(%)		
Reasons for supplementation					**45.028(*)**	**0.000**
To increase egg yield	-	-	9(5.6)	9(2.3)		
To increase both egg & meat yield	16(17)	-	8(5)	24(6.2)		
To increase egg &meat yield ,and maintain health	78(83)	131(100)	140(87.5)	349(90.6)		
To increase egg ,meat yield, broodiness & maintain health	-	-	1(0.6)	1(0.3)		
To increase egg & meat yield, age & maintain health	-	-	1(0.6)	1(0.3)		
To increase egg ,meat yield, broodiness, age & maintain health	-	-	1(0.6)	1(0.3)		
Perceived benefits due to extra supplements					**43.427(*)**	**0.000**
Egg yield	-	-	3(1.9)	3(0.8)		
Egg yield & growth	17(18.1)	-	4(2.5)	21(5.5)		
Egg yield, growth & improved health status	77(81.9)	131(100)	153(95.6)	361(93.8)		
Season of extra feeding					**30.272(*)**	**0.001**

Spring		-	-	1(0.6)	1(0.3)		
Winter		38(40.4)	49(37.4)	101(63.1)	188(48.8)		
Summer		56(59.6)	81(61.8)	56(35)	193(50.1)		
Same feed required in all seasons		-	-	1(0.6)	1(0.3)		
Spring and winter		-	-	1(0.6)	1(0.3)		
Summer and spring		-	1(0.8)	-	1(0.3)		
Reasons for providing additional feed and critical seasons for chicken feed shortages						**26.138(*)**	**0.000**
Season	**Reasons**						
Rainy	Lack of grain supplements and household food leftovers	56(59.6)	82(62.6)	56(35)	194(50.4)		
Dry	Lack of scavengeable green feeds & worms	38(40.4)	49(37.4)	104(65)	191(49.6)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

Housing

The survey found that nearly all households provided night shelters for their chickens (Table 7). Variations were noted in the proportions of different types of separate chicken houses and the frequency of cleaning chicken houses per week across agro-climates (p<0.05). However, there were no significant differences in cleaning practices (p>0.05). Overall, 59.5% of respondents built separate houses for their chickens, while 40.5% housed their chickens in various locations, such as the kitchen (7%), the family dwelling (26.8%), trees (0.5%), bamboo cages (4.7%), local bins inside the family dwelling (1.3%), and metal cages (0.3%). Two types of separate houses were identified: permanent houses (56.1%) used year-round and temporary houses (3.4%) constructed for the dry season. In the Dega agro-climate, chicken owners housed their chickens in the kitchen (1.6%) or inside the family dwelling (1.8%) due to the vulnerability of temporary houses to damage from heavy rains.

A higher proportion of respondents in the Kolla agro-climate (61.2%) constructed separate poultry houses compared to the Weyna dega (58.8%) and Dega (57.5%). In the Dega, 13.9% of respondents constructed temporary separate chicken houses, with 6.4% moving chickens inside kitchens during the rainy season and 7.4% moving them inside family dwellings due to heavy rains. No seasonal separate houses in Kolla and Weyna. Night shelter inside family dwellings was more common in the Dega (28.7%) compared to the Kolla (27.5%) and Weyna dega (24.4%). Night shelter inside local bins made from cow dung and mud was reported by 2.1% of households in the Dega, while night shelter inside kitchens was reported by 11.5% in the Weyna dega. Metal cages were used for night shelter by 0.8% of respondents in the Weyna dega, while bamboo cages were used by 6.9% in the Kolla. Tree perching was observed in the Kolla (1.2%).

The current findings are consistent with previous studies conducted in various parts of Ethiopia (Wondu *et al.*, 2013; Hailu *et al.*, 2019; Meskerem *et al.*, 2019). However, this result was higher than the lower percentages reported in other studies from different areas of Ethiopia (Samson and Endalew, 2010; Addisu *et al.*, 2013; Letebrhan *et al.*, 2015; Haile and Biratu, 2017; Asmelash *et al.*, 2018; Aman *et al.*, 2019; Assefa and Ewuneta, 2020).

Overall, 57.7% of the respondents reported cleaning their chicken houses, while 40.5% cleaned their chickens' night shelters to maintain a clean family house. Only 1.8% of the respondents did not practice cleaning chicken houses at all. The results showed that 66% of the households interviewed cleaned their chicken houses seven times per week, followed by three times per week (13.2%), once per week (7.8%), twice per week (7.5%), four times per week (2.6%), no cleaning (2.1%), five times per week (0.5%), and once per month (0.3%). Similar findings were reported in North West Ethiopia (Halima, 2007), where 74.02% of respondents cleaned the chicken house once a day and 11.06% cleaned it twice a day per week. In the mid-rift valley of Oromia (Samson and Endalew, 2010), 81% of households cleaned the chicken house once a day and 14% cleaned it twice a day per week. In the Dedo district of Jimma zone (Meskerem *et al.*, 2019), 88.3% of households cleaned the chicken house once a day and 11.7% cleaned it every two to three days. However, these findings differ from those reported by Hailu *et al.* (2019) in the Sheka Zone of South Western Ethiopia, where 22.9%, 53.1%, 20.2%, and 3.7% of households cleaned their chicken houses once a day, once a week, once a month, and above a month, respectively.

Table 7: The housing practices, types of chicken houses and cleaning frequency

Variables	**Agro-climatic zones**				**X^2-test**	**p-value**
	Dega n(%)	**Weyna dega n(%)**	**Kolla n(%)**	**Total n(%)**		
Separate poultry house other than family dwellings					**13.799(*)**	**0.001**
Yes ,permanent	41(43.6)	77(58.8)	98(61.2)	216(56.1)		

Yes, seasonal house	13(13.9)	-	-	13(3.3)		
No	40(42.6)	54(41.2)	62(38.8)	156(40.5)		
Chicken house types					**11.319(*)**	**0.003**
Permanent separate house	41(43.6)	77(58.8)	98(61.2)	216(56.1)		
Temporary (seasonal) separate house	13(13.9)	-	-	13(3.3)		
Separate house in dry Season, but housed inside family dwelling in rainy season	7(7.4)	-	-	7(1.8)		
Separate house in dry season but housed inside kitchen in rainy season	6(6.4)	-	-	6(1.6)		
Kitchen in dry and wet Season	9(9.6)	15(11.5)	3(1.9)	27(7)		
Family dwelling	27(28.7)	32(24.4)	44(27.5)	103(26.8)		
Perch on trees	-	-	2(1.2)	2(0.5)		
Bamboo cages	2(2.1)	5(3.8)	11(6.9)	18(4.7)		
Bin(*Ducon*) poultry house made inside family dwellings	2(2.1)	1(0.8)	2(1.2)	5(1.3)		
Metal cages (*Bermil*)	-	1(0.8)	-	1(0.3)		
Poultry house cleaning practice					**0.065(ns)**	**0.968**
Yes	54(57.4)	76(58)	92(57.5)	222(57.7)		
No	-	1(0.8)	6(3.8)	7(1.8)		
Yes, but not purposely for chicken	40(42.6)	54(41.2)	62(38.8)	156(40.5)		
Poultry house cleaning frequency per week					**10.294(*)**	**0.006**
Once	8(8.5)	13(9.9)	9(5.6)	30(7.8)		
Twice	5(5.3)	13(9.9)	11(6.9)	29(7.5)		
Three times	15(16)	24(18.3)	12(7.5)	51(13.2)		
Four times	3(3.2)	3(2.3)	4(2.5)	10(2.6)		
Five times	-	-	2(1.2)	2(0.5)		
Seven times	62(66)	76(58)	116(72.5)	254(66)		
Once /month	-	-	1(0.6)	1(0.3)		
Not cleaning	1(1.1)	2(1.5)	5(3.1)	8(2.1)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

Chicken producers in the three agro-climates showed similar attitudes towards the benefits of separate chicken houses, with all respondents (100%) agreeing that constructing separate chicken houses is advantageous (Table 8). The primary reason for building separate poultry houses was to protect chickens from predators. However, factors such as lack of awareness and insufficient extension support hindered the construction of separate chicken houses (Table 9). Similar findings were reported in various parts of Ethiopia (Moges *et al.*, 2014 ; Haile and Biratu, 2017; Aman *et al.*, 2019), where lack of knowledge (awareness), scarcity and cost of construction materials, risk of predators, risk of theft, and having only a small poultry flock were cited as major reasons for not building separate chicken houses.

Table 8: Benefits of constructing separate poultry houses

Variables	**Agro-climatic zones**				**X^2-test**	**p-value**	
	Dega n(%)	**Weyna dega n(%)**	**Kolla n(%)**	**Total n(%)**			
Do you think a separate house is beneficial?					**0.00(ns)**	**1.00**	
Yes	94(100)	131(100)	160(100%)	385(100)			
No	-	-	-	-			
Benefits	**Advantages in Kolla agro-climatic zone**						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Protection from predators	152	8	0	0	0	0	0.205

Neatness	0	8	15	60	31	46	0.084
Prevent disease transmission from birds to human /birds	70	21	35	11	18	5	0.159
Easiness of poultry product collection	125	25	10	0	0	0	0.197
Prevention from warm & coldness	85	30	23	8	12	2	0.173
Prevention of chicken damage (death) by human or large animals	102	24	20	9	5	0	0.183
	Advantages in Weyna dega agro-climatic zone						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Protection from predators	111	12	6	2	0	0	0.203
Neatness	51	38	20	12	6	4	0.169
Prevent disease transmission from birds to human /birds	82	18	11	13	7	0	0.182
Easiness of poultry product collection	40	48	19	15	3	6	0.165
Prevention from warm & coldness	0	22	10	19	56	24	0.092
Prevention of chicken damage (death) by human or large animals	80	33	9	7	2	0	0.190
	Advantages in Dega agro-climatic zone						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Protection from predators	80	10	4	0	0	0	0.239
Neatness	14	7	3	70	0	0	0.150
Prevent disease transmission from birds to human /birds	70	9	6	9	0	0	0.226
Easiness of poultry product collection	0	3	5	6	50	20	0.076
Prevention from warm & coldness	0	1	8	12	28	45	0.076
Prevention of chicken damage (death) by human or large animals	74	10	6	4	0	0	0.232
	Advantages in Western Zone of Tigray						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Protection from predators	343	30	11	2	0	0	0.216
Neatness	65	60	38	142	37	50	0.133
Prevent disease transmission from birds to human /birds	222	48	52	33	25	5	0.185
Easiness of poultry product collection	173	76	34	21	53	26	0.167
Prevention from warm & coldness	85	53	41	39	96	71	0.126
Prevention of chicken damage (death) by human or large animals	209	67	35	20	7	0	0.172

Table 9: Issues faced by households when constructing separate poultry houses

Issues	**Issues in Kolla agro-climatic zone**						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Lack of awareness about poultry house	95	50	15	0	0	0	0.550
Labor scarcity	11	1	1	8	3	0	0.066
Fear of predators attack	0	0	2	0	2	0	0.007
capital scarcity	0	22	15	0	0	0	0.106
land scarcity	24	3	0	0	0	0	0.099
Weak extension support	0	42	8	10	0	3	0.172
	Issues in Weyna dega agro-climatic zone						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**

Lack of awareness about poultry house	44	4	2	0	0	0	0.385
Labor scarcity	13	1	1	7	0	0	0.142
Fear of predators attack	5	1	2	0	7	0	0.075
capital scarcity	0	14	8	0	0	0	0.135
land scarcity	2	0	0	0	0	0	0.016
Weak extension support	0	30	7	3	0	0	0.247
	Issues in Dega agro-climatic zone						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Lack of awareness about poultry house	41	5	0	0	0	0	0.499
Labor scarcity	5	1	1	1	0	0	0.077
Fear of predators attack	3	0	0	0	1	0	0.037
capital scarcity	0	5	2	0	0	0	0.061
land scarcity	8	0	0	0	0	0	0.088
Weak extension support	0	25	1	0	0	0	0.238
	Issues in western zone of Tigray						
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**Index**
Lack of awareness about poultry house	180	59	17	0	0	0	0.497
Labor scarcity	29	3	3	16	3	0	0.088
Fear of predators attack	8	1	4	0	10	0	0.031
capital scarcity	0	41	25	0	0	0	0.105
land scarcity	34	3	0	0	0	0	0.075
Weak extension support	0	97	16	13	0	3	0.204

Table 10 displays the materials used for poultry house construction, egg collection practices, and the egg-laying nests and incubating facilities among chicken producers. In the Weyna dega agro-climate, a higher proportion of households used mud and wood blocks (42%) as construction materials compared to Dega (35.1%) and Kolla (15%) areas. Sole wood was used by 0.8% and 1.2% of respondents in the Weyna dega and Kolla agro-climate, respectively, but none in the Dega. A higher proportion of respondents in the Dega (14.9%) used bamboo or grasses with wood for construction compared to the Kolla (12.5%) and Weyna dega (4.6%). Iron sheet roofs were more common in the Kolla (29.4%) compared to the Weyna dega (11.5%) and Dega (8.5%). Wood, plastic materials, grasses, iron sheet roofs, and bamboo sole were used by a small percentage of respondents in the Kolla agro-climate, but not in the Weyna dega or Dega agro-climate. These materials may not provide adequate warmth and protection against extreme cold, making chickens more vulnerable to predators at night. For laying nests, 14.3% of respondents prepared them, with 4.2% using common nests for all layers and 9.9% using individual nests. A higher percentage of respondents in the Kolla (19.4%) prepared laying nests, while the Dega had a lower percentage (12.8%) and the Weyna dega had a slightly lower percentage (9.2%).

Egg collection practices varied across agro-climates. In the Dega and Weyna dega, all respondents collected laid eggs properly, while in the Kolla, the proportion was 92.5%. However, some respondents in the Kolla agro-climate did not collect eggs (3.8%), collected eggs as needed (2.5%), or left eggs for incubation in the laying nest while collecting others for consumption (1.2%). This suggests differences in perception among chicken producers regarding the importance of proper egg handling before incubation, which can affect hatchability and fertility. These variations may be influenced by the level of extensional support provided in each agro-climate.

Properly collecting and storing eggs before incubation is crucial for improving hatchability and fertility. Mishandling can enlarge the pores of eggs, leading to spoilage and reduced hatchability. Regular collection prevents damage and contamination. Daily turning of eggs is recommended for embryo survival and better hatchability.

Table 10: House construction materials and egg laying nest facilities

Variables	Agro-climatic zones				X^2-test	p-value
	Dega n(%)	Weyna dega n(%)	Kolla n(%)	Total n(%)		
Housing construction Materials					**34.129 (*)**	**0.000**
Mud of blocks (mud and wood)	33(35.1)	55(42)	24(15)	112(29.1)		

Iron sheet roof	8(8.5)	15(11.5)	47(29.4)	70(18.2)		
Bamboo /grasses with wood	14(14.9)	6(4.6)	20(12.5)	40(10.4)		
Wood (*eg. Securinega Virosa*)	-	1(0.8)	2(1.2)	3(0.8)		
Plastic materials	-	-	1(0.6)	1(0.3)		
Grasses ,Iron sheet roof and wood	-	-	1(0.6)	1(0.3)		
Bamboo only	-	-	2(1.2)	2(0.5)		
Nest preparation for egg- laying hens					**6.356(*)**	**0.042**
Yes	12(12.8)	12(9.2)	31(19.4)	55(14.3)		
No	82(87.2)	119(90.8)	129(80.6)	330(85.7)		
The laying nest					**6.344(*)**	**0.042**
Common for all layers	1(1.1)	2(1.5)	13(8.1)	16(4.2)		
Individual	11(11.7)	10(7.6)	17(10.6)	38(9.9)		
Lay everywhere(no purposely made laying nest	82(87.2)	119(90.8)	130(81.2)	331(86)		
Incubating place preparation for hen					**0.00(ns)**	**1.00**
Yes	94(100)	131(100)	160(100)	385(100)		
No	-	-	-	-		
Laid eggs collection practice					**17.368(*)**	**0.000**
Yes	94(100)	131(100)	148(92.5)	373(96.9)		
No	-	-	6(3.8)	6(1.6)		
As necessary	-	-	4(2.5)	4(1)		
Eggs for incubation remain in the laying nest while eggs for consumption are collected	-	-	2(1.2)	2(0.5)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

Watering and Water Resources

Significant variations were found among the agro-climates in terms of water sources, water supply containers, frequency of cleaning water holding containers, frequency of water provision, and distance from homesteads to both well and tap water ($p<0.05$).

However, there were no variations observed in the proportions of households providing water for their chickens and the distance of the river from their homesteads (Table 12). These findings are consistent with previous studies conducted in various parts of Ethiopia (Addisu *et al.*, 2013;Tadesse *et al.*, 2013; Letebrhan *et al.*, 2015; Haile and Biratu,2017; Aman *et al.*, 2019; Assefa and Ewuneta,2020), where 100% of households offered water for their chickens. In contrast, different results were reported in Bure district (Moges *et al.*, 2010) and the West Amhara region of Ethiopia (Worku *et al.*,2012), where 86.4% and 86.2% and 14.3% and 10.2% of respondents provided water for their chickens during the dry season and year-round, respectively.

Table 11 displays the water provision practices and sources of drinking water for chicken producers in different agro-climates. In the Dega agro-climate, a higher percentage of respondents relied on rivers as their main water source (46.8%), compared to the Weyna dega (32.8%) and Kolla (11.2%). Conversely, in the Kolla area, a greater proportion of households used tap water (45%) as their primary water source, compared to the Dega (29.8%) and Weyna dega (9.2%). The Weyna dega had a higher percentage of respondents using wells as their major water source (42.7%), compared to the Kolla (31.7%) and Dega (17%).

In the Kolla area, village Kebeles serve as settlement areas for farmers from overpopulated regions of Tigray, other parts of Ethiopia, Sudan, and Eritrea. Consequently, most households in these areas use tap water as the drinking water source for themselves and their chickens, while rivers or wells are utilized for larger animals. Other studies also found different sources of drinking water for chickens in various regions of Ethiopia, such as springs, pipes, rivers, ponds, boreholes, hand dug wells, Tap and canals (Samson and Endalew,2010; Worku *et al.*, 2012; Tadesse *et al.*, 2013; Nebiyu *et al.*, 2013; Haile and Biratu, 2017; Meskerem *et al.*, 2019).

Households in the study area utilized a variety of homemade waterers for their chickens, made from materials such as plastic, stone, wood, metal, and broken pieces of pot and gourd (Table 11). These waterers were frequently positioned in open areas, which raised the risk of disease transmission from wild birds, dogs, and cats. Advising farmers to position waterers and feeders within the coop or run can reduce contamination risks. Several studies conducted in different regions of Ethiopia have identified various locally made waterers used for providing water to chickens. These waterers include clay, plastic, wooden, stone, and metal (tin can and nickel) troughs (Halima, 2007; Mekonnen, 2007; Bogale, 2008; Meseret, 2010; Worku *et al.*, 2012; Letebrhan *et al.*, 2015;

Haile and Biratu, 2017; Aman *et al.*, 2019).

Eighty-six percent of respondents in the study area cleaned chicken waterers, while 14% did not (Table 12). The frequency of cleaning waterers varied among farmers, ranging from once a day to twice a day. However, it's important to note that poorly cleaned waterers and feeders are prone to contamination, creating a breeding ground for harmful microorganisms. To maintain flock health and egg production, it's crucial to clean chicken waterers every time water is provided.

This aligns with Halima's research (2007), which found that cleaning practices varied, with 31.52% cleaning waterers daily, 23.77% cleaning when dirty, 6.38% cleaning with each provision, and 5.37% cleaning twice a day. Conversely, 32.96% of respondents in North West Ethiopia never cleaned their chickens' waterer. Similar trends were seen in the Fogera district, where 70.8% cleaned waterers daily, 20.8% weekly, 2.8% monthly, and 1.4% more than monthly (Bogale,2008).

Most farmers in the study area provided water for their chickens ad libitum (70.9%), once a day (7.5%), and twice a day (21.6%) (Table 12), which aligns with Tadesse *et al.*'s findings (2013), where 96.1% of households offered free access to water for their chickens. The remaining 0.5% provided water in the morning only, and 3.9% provided water both in the morning and evening in East Shewa, Ethiopia. Farmers in the mid-rift valley of Oromia provided water for chickens throughout the day (47%), once per day (14%), twice a day (18%), three times a day (16%), or four times a day (5%) (Samson and Endalew, 2010). Assefa and Ewuneta (2020) reported similar findings in the Meket district of North Western Ethiopia, where farmers provided water for chickens once a day (79.2%), twice a day (16%), and three times or more a day (5.85%). In Jimma and Ilu Aba Bora zones of Ethiopia, farmers provided water for their chickens once a day (22.2%) and ad libitum (77.8%) (Haile and Biratu, 2017). However, in the Dedo district of Jimma zone of Ethiopia, farmers offered water for their chickens throughout the year (56%) and only during the dry period (44%) (Meskerem *et al.*, 2019).

The study found that among the beneficiaries of river water, their homesteads were located at varying distances from the river: <1km (3.6%), 1-5km (26%), 5-8 km (2.6%), 8–10 km (0.6%), and >10 km (0.6%). Similarly, those using well water had their homesteads situated far from the well, with distances of <1km (26.5%), 1–5 km (9.9%), 5-8 km (1.3%), 8–10 km (2.6%), or >10 km (0.3%). Likewise, tap water beneficiaries had their homesteads located at distances of <1 km (31.7%), 1–5 km (7%), or 5-8 km (0.5%). Overall, the study indicated that chicken producers in the area had positive experiences with water provision for their chickens.

Providing chickens with regular access to clean water is crucial for enhancing their productivity. Educating chicken producers about the importance of water through training programs can boost sustainable chicken productivity, economic returns, and food security for small-scale farmers. According to Jacquire (2015), water is vital for digestion, body temperature regulation, and waste elimination in chickens and a consistent supply of clean water is critical for egg production. Without water, dry feed can congeal in the crop, leading to reduced blood supply to the brain, causing paralysis or death.

Table 11: Watering practice, water resources, and water supply containers

Variables	**Agro-climatic zones**				**X^2-test**	**p-value**
	Dega n(%)	**Weyna dega n(%)**	**Kolla n(%)**	**Total n(%)**		
Watering practice					**0.000(ns)**	**1.00**
Yes	94(100)	131(100)	160(100)	385(100)		
No	-	-	-	-		
Water resources					**95.685(*)**	**0.000**
River	44(46.8)	43(32.8)	18(11.2)	105(27.3)		
Tap water	28(29.8)	12(9.2)	72(45)	112(29.1)		
Well	16(17)	56(42.7)	50(31.2)	122(31.7)		
River and tap water	4(4.3)	1(0.8)	11(6.9)	16(4.2)		
River and well	2(2.1)	4(3.1)	-	6(1.6)		
Tap water and well	-	15(11.5)	9(5.6)	24(6.2)		
Waterers					**60.216 (*)**	**0.000**
Metal(dish or *bredisti*)	4(4.3)	12(9.2)	22(13.8)	38(9.9)		
Stone made	20(21.3)	28(21.4)	6(3.8)	54(14)		
Broken pieces of pot	11(11.7)	7(5.3)	13(8.1)	31(8.1)		
Plastic made	38(40.4)	65(49.6)	107(66.9)	210(54.5)		
Wood (*Hilab* or *Galibba*)	18(19.1)	17(13)	6(3.8)	41(10.6)		
Broken piece of pot & plastic	2(1.2)	-	1(0.6)	3(0.8)		

Wood & stone made	1(1.1)	-	1(0.6)	2(0.5)		
Wood and metal made	-	-	1(0.6)	1(0.3)		
Metal and plastic made	-	2(1.5)	2(1.2)	4(1)		
Gourd (*Kil*)	-	-	1(0.6)	1(0.3)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

Table 12: Frequency of washing waterers and the distance of water sources from the homestead

Variables	Agro-climatic zones				X^2-test	p-value
	Dega n(%)	Weyna dega n(%)	Kolla n(%)	Total n(%)		
Washing frequency of containers /week					**32.341(*)**	**0.009**
Once	20(21.3)	15(11.5)	18(11.2)	53(13.8)		
Twice	9(9.6)	20(15.3)	13(8.1)	42(10.9)		
Three times	17(18.1)	17(13)	33(20.6)	67(17.4)		
Four times	2(2.1)	5(3.8)	4(2.5)	11(2.9)		
Five times	-	1(0.8)	-	1(0.3)		
Six times	1(1.1)	1(0.8)	-	2(0.5)		
Seven times	34(36.2)	42(32.1)	78(48.8)	154(40)		
None	11(11.7)	29(22.1)	14(8.8)	54(14)		
Twice / day	-	1(0.8)	-	1(0.3)		
Watering Frequency/day					**2.864(ns)**	**0.581**
Once	8(8.5)	11(8.4)	10(6.2)	29(7.5)		
Twice	25(26.6)	27(20.6)	31(19.4)	83(21.6)		
Adlib	61(64.9)	93(71)	119(74.4)	273(70.9)		
Distance of river from homestead					**6.5(ns)**	**0.591**
<1 km	15(16)	51(38.9)	36(22.5)	102(26.5)		
1-5 km	2(2.1)	23(17.6)	13(8.1)	38(9.9)		
5-8 km	-	1(0.8)	4(2.5)	5(1.3)		
8-10 km	1(1.1)	-	9(5.6)	10(2.6)		
>10 km	-	-	1(0.6)	1(0.3)		
Distance of Tap water from homestead					**31.556(*)**	**0.000**
<1 km	30(31.9)	12(9.2)	80(50)	122(31.7)		
1-5 km	3(3.2)	13(9.9)	11(6.9)	27(7)		
5-8 km	-	2(1.5)	-	2(0.5)		

** (p<0.05) & ns (p>0.05) at p (0.05) and n=number households interviewed*

CONCLUSION

Respondents in the study provided additional feeds to their chickens for improved yields and health, using farm-produced and market-purchased feeds, with different cereal crops based on agro-climates. Cereal crops were mainly from harvests, while non-cereal feeds were purchased. Farmers fed their chickens three times a day, facing challenges in sourcing enough feed during dry and wet seasons. Encouraging strategic supplementation could enhance meat and egg production, ensuring food security.

Out of the respondents, 59.5% constructed separate chicken houses, with 56.1% having permanent structures and 3.4% using temporary ones. The remaining 40.5% housed their chickens in various places such as kitchens, family dwellings, trees, bamboo cages, or inside the family home. 57.7% of the respondents cleaned their chicken houses daily, while 2.1% did not clean at all. The houses were constructed using materials like mud, wood, iron sheets, bamboo, grass, and plastic.

All respondents provided water for chickens, with 70.9% offering it ad libitum, 7.5% once a day, and 21.6% twice a day. The water sources included wells, tap water, and river water, and the waterers were made from various materials such as plastic, stone, wood, metal, broken pots, and gourds. Eighty-six percent of the respondents cleaned the chicken waterers, while the remaining fourteen percent did not. This indicates an improving understanding of proper water provision and feed supplementation for chickens, but there is still a need for training in areas such as house construction, feeding, watering, sanitation, and cleaning to prevent waterborne diseases.

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