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Research Article

Study on Productive Performances, Constraints, and Opportunities of Improved Chicken under Village Production System in West Shewa Zone, Ethiopia

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The study was conducted to determine productive performances, constraints, and opportunities of Bovans Brown (BB), Sasso, and crossbred chickens under village production system in Gindeberet district of West Shewa, Ethiopia. A total of 139 randomly selected smallholder chicken producers were involved in the study from six purposefully selected peasant associations (PAs) from the district. Information was gathered on average egg production/year, age at the first egg laying, constraints, and opportunities of improved chicken production during the study. The data collected were analyzed using Statistical Package for Social Science (SPSS) version 24, and *Z*-test was employed to test the difference among agro-ecologies on a certain variable. The mean annual eggs produced by BB (189.34 ± 0.99 eggs/hen/year) and by Sasso (180.82 ± 0.9 eggs/hen/year) were higher than those of crossbred chicken (111.26 ± 0.77 eggs/hen/year). Moreover, a significant difference ($p < 0.05$) was observed for crossbred and exotic chickens' egg production performances between agro-ecological zones. The mean age at the first egg laying (182.28 ± 1.61 days) of crossbred chickens was higher than the mean age at the first egg laying (164.29 ± 0.41 days) of exotic chickens. Also, the mean age at the first egg laying of improved chicken breeds was statistically significant ($p < 0.05$) between agro-ecological zones. Prevalence of disease, inadequate veterinary services, predators, and shortage of balanced concentrate mixture feeds were among the constraints hindering improved chicken production in the study area. However, high demand of chicken and chicken products, participation of NGOs in dissemination of improved chicken, presence of government policy, and availability of manpower were the major potentials encouraging chicken production in the study area. Therefore, practical poultry production training and extension should get primary emphasis to combat the existing constraints. Therefore, good poultry management practices should be promoted to improve chicken productivity in the study area.

1. Introduction

Poultry farming is widely practiced in Africa and accounts for about 1.5 billion chicken, 80% of them belonging to local chicken population [1]. Poultry production has an important economic, social, and cultural benefit and plays a significant role in family nutrition in the developing countries. The proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, the major increase being in the developing world. It has been estimated that 80% of the poultry population in Africa is found in traditional scavenging systems [2]. The poultry sector in Ethiopia is characterized into three major production systems, namely, large commercial, small scale commercial, and village or backyard poultry production systems, and each can sustainably coexist and contribute to solve the socioeconomic problems of different target societies [3]. The Central Statistics Agency [4] report revealed that 78.85% of the total poultry population comprise indigenous birds and 12.03% are hybrid, while 9.11% are exotic breeds.

To improve the poultry production, several exotic chicken breeds have been disseminated to the farmers over the last 50 years. However, the adoption of these exotic chicken breed in most parts of the country is not promising due to its hindrance by a set of factors including sub-optimal management, lack of supplementary feed, and high mortality rate due to diseases and predators [5]. Like that, with the aim of improving poultry productivity, there has been a substantial effort to introduce improved hybrid layer chickens particularly Bovans Brown, Sasso, and crossbred chicken to smallholder farmers under backyard management in Gindeberet district. However, lack of recorded data on the productive performance of chicken makes it difficult to assess the importance and contributions of the past attempts to improve the sector [6]. In addition, most of the exotic breeds studied under village production system are not a high yielding hybrid type used in the international poultry industry [7]. In view of the above, a systematic study to evaluate productive performance, constraints, and opportunities of improved poultry chicken under village production system was conducted in Gindeberet district, West Shewa, Ethiopia.

2. Materials and Methods

2.1. Description of the Study Area. The study was conducted in Gindeberet district, West Shewa Zone of Ethiopia (Figure 1), between astronomical grids of 9021′ to 9050′ N and 37037′ to 38008′ E. It is located at about 193 km from Addis Ababa, the capital city of Ethiopia. The district had an elevation ranging from 1500 to 2500 m.a.s.l. with a total area of about 2417.82 km^2. The area is characterized by high average temperature (20–25°C) and minimum rainfall (300–600 mm) (district meteorological document, 2020). Mixed crop-livestock farming is the main agricultural activity practiced in the study area.

2.2. Sample Size and the Selection of the Study Households. The district was stratified into mid-land (1500–2500 m.a.s.l) and low-land (1000–1500 m.a.s.l) based on agro-ecologies. Then, six peasant associations (PAs) (*Kebele)* from each agro-ecology were selected based on the extent, intensity, and accessibility of improved chicken production. The target population was smallholder poultry producers in the six peasant associations keeping crossbred, exotic, or both breeds of chickens. A list of poultry producers in the area was obtained from the Livestock and Fishery Resources Development Office (LFRDO) of the respective district. As a result, 800 smallholder chicken producers from the six peasant associations were included as a sampling frame (557 from mid-land agro-ecology and 243 from low-land agro-ecology). Then, according to the size of the sampling frame, 139 respondents (103 from mid-land agro-ecology and 36 from low-land agro-ecology) were randomly selected and used for an interview (Table 1). Before the interview, selected chicken producers were briefed on the purpose of the study and confidentiality of all information to be provided.

2.3. Data Collection and Analysis. Survey was carried out to collect both primary and secondary data and to generate reliable information on the intended topic. Secondary data were collected from the district Livestock and Fishery Resources Development Office, published journal articles, reports, and other relevant documents, while primary data were collected from selected households using semi-structured questionnaires. In order to collect reliable information regarding the objectives of the topic, pretest of questionnaires was conducted at aforementioned district and amendment was made for final interview. Each questionnaire was filled by trained enumerators, and close supervision was followed by the researchers. Focus group discussions and field observations were also made to validate the primary data collected from the respondents. The questionnaire was developed based on [8,9] to collect the data of productive and reproductive performances of improved chickens in the study area. Then, the collected data were analyzed using SPSS version 24.0 software. To test the difference among agro-ecologies on certain variables, Z-test and chi-square test were employed. The ranking of constraints that hamper and opportunities that encourage improved chicken production in the study area were done using the rank index formula as described by Musa et al. (2006):

Rank index = sum of (n*percent of house hold ranked first) + (n*percent of house hold ranked second) + (n* percent of household ranked third) + (n*percent of households ranked fourth) + (n*percent of + household + ...+1 ranked last) given for each factor divided by the total sum of (n* % of household ranked first) + (n*% of household ranked second) + (n*% of households ranked third) + (n*% percent of households ranked fourth+. . .+ 1(n*% of household ranked last) for overall reasons.

3. Results and Discussion

3.1. Productive and Reproductive Performances of Exotic Chickens. The mean age at the first lay of Bovans Brown (BB) and Sasso chickens was 164.3 ± 0.4 and 173.7 ± 0.8 days, respectively (Table 2). The results of the current study disagreed with the mean age at the first lay of improved chicken (189.9 days and 195.9 days) reported in [10,11], respectively. The finding (165.5±13.2) age at the first laying of Bovans Brown reported in [12] from East Shewa Zone, Ethiopia, was agreed with the current result. However, the mean age at the first laying of Sasso reported in the current study was higher than the mean age at the first egg dropping of Sasso (142.76 ± 0.85) days reported by Aman et al. [13] under village production system in SNNPR, Ethiopia. Sasso was later in sexual maturity than Bovans Brown, according to the age at the first lay reported by farmers in the study area. Furthermore, age at the first egg dropping of Sasso in low agro-ecology was significantly different ($p < 0.05$) than mid-agrology, and similarly low agro-ecology BB chickens have lower age at first egg dropping than those of mid-agro-ecology breeds. This might be due to variation in breeds, availability of feed resources across agro-ecologies, and management system of the owners.

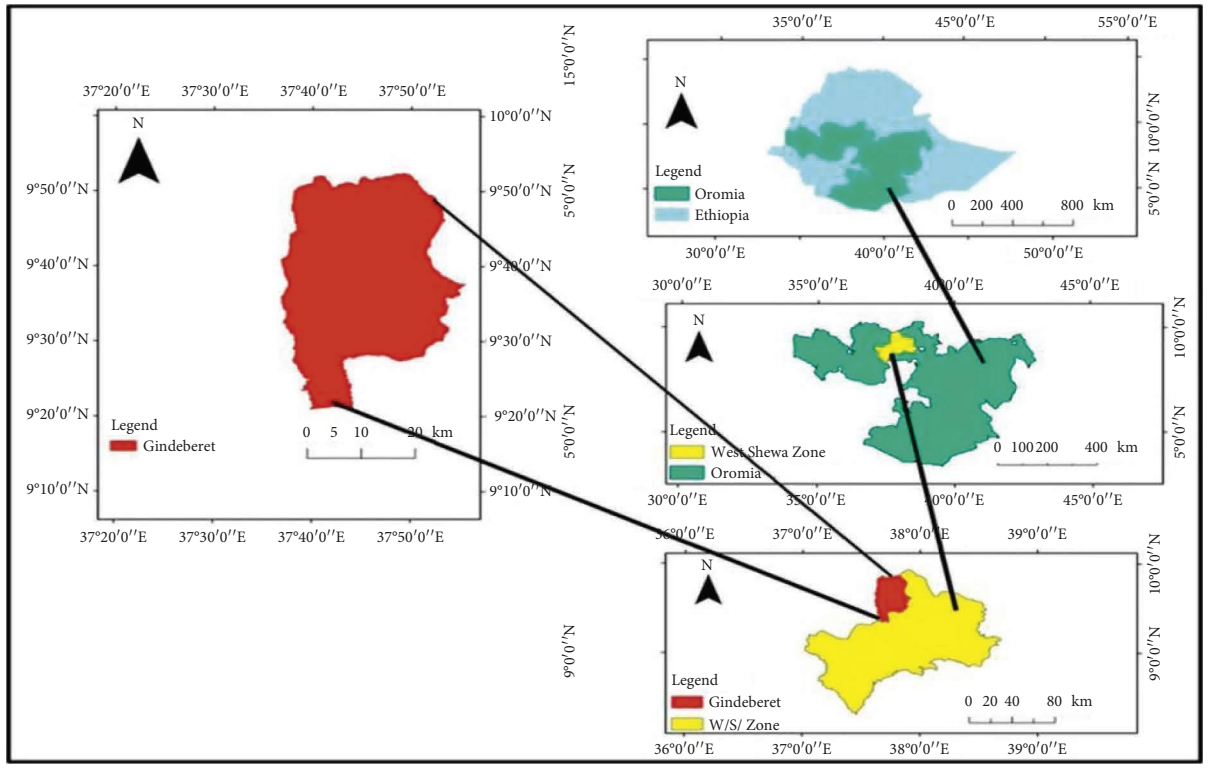

Figure 1: Map of the study area.

Table 1: Proportionate distribution of poultry farmers according to district agro-ecological zones.

Agro-ecologies	Peasant associations (PAs)	Estimated number of chicken producer farmers	Proportion	Number of respondents selected
Mid-land	Kachise	82	(82/800)x82	8
	Gemeda	186	(186/800)x186	43
	D/Fajji	164	(164/800)x164	33
	S/Borqi	125	(125/800)x125	19
	Total	557		103
Low-land	Qiltu sanbata	1382	(138/800)x138	23
	Bake Fayina	105	(105\800)x105	13
	Total	243		36
Total		800		139

Table 2: Reproductive and productive performances of exotic chicken.

Variables	Agro-ecology		Overall	p value
	ML ($N = 103$) Mean ± SE	LL ($N = 36$) Mean ± SE	Mean ± SE	
Egg production per year (BB)	190.80 ± 1.385	187.67 ± 1.403	189.34 ± 0.993	0.116
Pullets age at start egg laying (BB) (days)	165.07 ± 0.524	163.39 ± 0.624	164.29 ± 0.409	0.04
Cockerel age at start to mating (BB) (days)	161.60 ± 0.777	157.59 ± 2.545	159.73 ± 1.262	0.113
Egg production per year (Sasso)	181.16 ± 1.154	180.43 ± 1.430	180.82 ± 0.904	0.688
Pullets age at start egg laying (Sasso) (days)	173.79 ± 1.144	173.52 ± 1.211	173.66 ± 0.829	0.876
Cockerels age at start to mating (Sasso) (days)	154.00 ± 0.767	150.59 ± 2.411	152.41 ± 1.199	0.157
Number of egg incubated	7.21 ± 0.086	7.10 ± 0.190	7.16 ± 0.068	0.4
Number of egg hatched	4.64 ± 0.074	4.59 ± 0.079	4.62 ± 0.0536	0.626
Hatchability rate	64.56%	64.25%	64.53%	

ML: mid-land; LL: low-land; N: number of respondents; SE, standard error.

Table 3: Reproductive and productive performances of crossbred chicken.

Variables	Agro-ecology		Overall	p value
	ML ($N = 103$) Mean ± SE	LL ($N = 36$) Mean ± SE	Mean ± SE	
Egg production per year (crossbred chicken)	128.49 ± 14.277	107.89 ± 1.247	118.89 ± 7.678	0.182
Pullets age at start egg laying (crossbred chicken)	183.84 ± 0.860	180.36 ± 2.901	182.22 ± 1.429	0.225
Cockerels age at start to mating (cross breeds) (days)	176.67 ± 0.813	177.07 ± 0.916	176.85 ± 0.607	0.747
Number of egg incubated	12.61 ± 0.129	12.41 ± 0.129	12.52 ± 0.092	0.267
Number of egg hatched	9.11 ± 0.143	9.15 ± 0.096	9.13 ± 0.088	0.852
Days of brooding	58.79 ± 0.104	58.80 ± 0.130	58.79 ± 0.082	0.915
Hatchability rate (%)	72.83%	73.31%	73.09%	

ML: mid-land; LL: low-land; N: number of respondents; SE, standard error.

Table 4: Ranking of constraints of improved chicken production in the study area.

Variable of constraints	Respondents' ranks (R)																Index	Ranked
	1st		2nd		3rd		4th		5th		6th		7th		8th			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
Prevalence of disease	93	71.00	22	16.80	8	6.10	1	0.80	3	2.30	2	1.50	1	0.80	1	0.80	2.341	1
Improper veterinary services	3	2.30	30	22.90	41	31.30	19	14.50	13	9.90	8	6.10	8	6.10	9	6.90	1.160	2
Attacks of predators	8	6.10	25	19.10	24	18.30	21	16.00	27	20.60	13	9.90	11	8.40	2	1.50	1.075	3
Shortage of concentrate feed	4	3.10	25	19.10	25	19.10	26	19.80	26	19.80	13	9.90	11	8.40	1	0.80	0.900	4
Lack of knowledge about modern chicken management	11	9.90	6	4.60	9	6.90	28	21.40	20	15.30	33	25.20	13	9.90	9	6.90	0.648	5
High price of concentrate feed	1	0.80	10	7.60	2	1.50	24	18.30	25	19.10	39	29.80	18	13.70	13	9.90	0.542	6
Lack of access market	4	3.10	11	8.40	19	14.50	9	6.90	7	5.30	8	6.10	52	39.70	21	16.00	0.503	7
Limited supply of improved chicken/breeds	7	5.30	3	2.30	3	2.30	7	5.30	11	8.40	14	10.70	15	11.50	71	54.20	0.249	8

Table 5: Opportunities of improved chicken production in the study area.

Variables of opportunity	Respondents' ranks (R)												Index	Ranked
	1st		2nd		3rd		4th		5th		6th			
	N	%	N	%	N	%	N	%	N	%	N	%		
High demand of chicken and chicken product	41	31.30	21	16.03	24	18.32	27	20.61	15	11.45	3	2.290	1.2029	1
Participation of NGOs in dissemination of improved chicken	29	22.14	40	30.53	20	15.27	20	15.27	10	7.63	12	9.160	1.0882	2
Presence of government policy which encourages chicken rearing	21	16.03	39	29.77	30	22.90	10	7.63	17	12.98	14	10.690	1.0344	3
Availability of manpower	14	10.69	7	5.34	30	22.90	18	13.74	28	21.37	34	25.950	0.5633	4
Availability of microfinance for loan	6	4.58	10	7.63	15	11.45	39	29.77	32	24.43	29	22.140	0.4844	5

Information on the egg production of different types of chicken breeds is depicted in Table 2. The BB laid the highest number of eggs (189.34 ± 0.409) followed by Sasso chicken (180.82 ± 0.90), and the differences were significant ($p < 0.05$). This could be attributed to difference in genetic potential of different strains used, availability of feed resources, and management system of the owners. This disagreed with the report of Bikila and Urge [14]. Generally, the reproductive and productive performances of exotic chicken were statistically insignificant at ($P < 0.05$) across the agroecology categories except pullets age at the first egg laying.

3.2. Reproductive and Productive Performance of Crossbred Chickens. The average mean age at first egg laying of crossbreed chicken in the study area was 182.28 ± 1.61 days (Table 3). The current finding was in line with the average age at the first egg laying (24 to 27 weeks) reported by [15] from Northern Tigray, Ethiopia. The average egg production per/year/hen for crossbred chicken in the study area was 111.26 ± 0.7 days. The average number of crossbred chicken eggs set for incubation in the study area was 12.49 ± 0.13 with hatchability percentage of 73.09 (Table 3). This hatchability percentage was lower than the finding (80.46%) of crossbred chicken under village management in Southern and Northern Tigray reported in [16]. Generally, no significant difference ($p < 0.05$) was observed between mid-altitude and high altitude regarding the reproductive and productive performances of crossbred chickens.

3.3. Constraints and Opportunities of Chicken Production in the Study Area. High prevalence of disease, improper veterinary services, attacks by predators, and shortage of concentrate feeds were among the constraints hindering chicken production in the study area according to their

priorities (Table 4). This coincided with the report of Tewodros and Getabalew [17]. Regardless of the problems and constraints that hinder the development of the sector, majority of chicken producers continue to produce and expand chicken production system in the study area because of the opportunities registered in Table 5. This was in agreement with the report of Aman et al. [13].

4. Conclusion and Recommendations

The result of this study revealed that the average age at the first egg laying and eggs laid/year/chicken for exotic chickens was higher than for crossbred chickens. High prevalence of diseases, inadequate veterinary services, shortage of concentrate feed, and the high price of concentrate feed were among the constraints hindering chicken production in the study area. Also, high demand for chicken and chicken products, participation of non-government organizations in the dissemination of improved chicken, availability of manpower, and so on were listed as encouraging potential for chicken production and expansion in the study area. Therefore, all stakeholders in the area should work in the integrated manner for the development of the sub-sector to benefit the farmers in particular and the country in genera.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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