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Research Article
Impact of Hybrid/Exotic Chicken Breed Distribution on Performances of Indigenous Chicken in South Western Ethiopia

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Abstract

Background and Objective: Poultry production is a vital livestock production system for most people living in low income countries, including Ethiopia. This study was conducted in South Western parts of Ethiopia with the aim of assessing the effectiveness and impacts of hybrid chicken breed distribution on performances and populations of indigenous chickens. **Materials and Methods:** A total of 384 respondents were randomly selected using a stratified sampling technique from purposively selected 6 districts. Qualitative and quantitative data were collected through direct observations, focused group discussions and questionnaires. **Results:** Majorities (69.5%) of respondents were female and 32% of respondents attended primary school education. About 45.1% of farmers keep their chickens in the kitchen and (36.5%) kept together with family and (18.5%) keep in separate houses. Maize, sorghum and household left over (39.8%) were the major feed sources in the study areas. Feed shortage (35.4%), disease (34.4%) and predators (30.2%) were the most important constraints. The result pertaining to the effectiveness of hybrid chicken breed distribution was described as high egg production, fast growth rate and highly demanded as compared to the indigenous chicken populations. However, the status of indigenous chicken populations has been decreasing (59.9%) and replaced by imported hybrid chicken breeds. **Conclusion:** The impacts of hybrid chicken breed distributions were reduced production of indigenous chicken (35.4%), gene dilution (18.8%), development of cannibalism and destruction of vegetables in the compound. Therefore, the present finding indicated production of indigenous chickens were immensely reducing and replacing by the imported chicken breeds. Thus, it is crucial to conserve and upgrade indigenous chicken which possesses useful genetic potentials that could be improved through systematic selection under a scavenging management system.

Key words: Breed distribution, effectiveness, gene dilution, hybrid chicken, indigenous chicken

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Indigenous chicken production is a vital livestock production system for most people living in Sub-Saharan African Country including Ethiopia. This type of livestock production is considered as easy and kept by poor living in low income countries like Ethiopia[1,2]. In addition, the indigenous chicken sector constitutes a significant contribution to human livelihood and contributes significantly to poverty alleviation, food security and economic empowerments for vulnerable groups, women and children[3,4].Currently, the total chicken population in Ethiopia is estimated about 56.53 million of which 94.31% are indigenous chickens which are mainly kept by smallholder rural farmers under scavenging management system. The remaining 3.21 and 2.49% are hybrid and exotic chickens, respectively[5].

The indigenous chickens which are predominantly kept by smallholder rural communities are selected naturally or by the farmers who keep them for their adaptive traits are often poor in their egg production, late in maturation and long broodiness[4,6,7]. According to Melesse *et al.*[8] and Egahi *et al.*[9] the indigenous chicken populations are gene reservoirs, particularly for those genes that have adaptive values which exotic breeds do not possess. Similarly, FAO[10] indicated that, indigenous breeds are hardy and well adapted to low-input systems, where commercial breeds might not survive or might respond with a dramatic decline in productivity. Even though the indigenous chickens are well adapted in harsh environmental conditions their contribution in relation to their large number is low. This is due to their poor genetic potential, poor nutrition, poor health care activities and little management given by the households.

Therefore, one of the strategies aimed to improve the performances of indigenous chicken in Ethiopia was introduction and distribution of exotic/or hybrid breeds to the indigenous environments. In line with this Halima *et al.*[11] reported that those high-input and high-output requiring exotic chicken breeds have been introduced and distributed by the government for the last two decades. Similarly, around four exotic/hybrid breeds such as white leghorns, rhode island red (RIR), bovans brown and sasso breeds have been distributed to improve performances of indigenous chicken populations, in South Western Ethiopia. However, the performance of the exotic or hybrid chicken breed was also lower than that which can be expected under scavenging management system[12]. This might be due to the effect of high ambient temperature and poor management problems. In addition, the contribution of these breeds interventions on improvements of indigenous chicken populations, their impacts and constraints have not been studied and yet known. Thus, this study was aimed to assess husbandry practices, impacts of the introduced hybrid chicken breed along with the major constraints in Kaffa, Bench Maji and Sheka Zones of South-Western Ethiopia.

MATERIALS AND METHODS

Description of the study area: This study was conducted from January-August, 2018 in Kaffa, Sheka and Bench Maji Zones of South Western Ethiopia. The three Zones are located in between 6°24'-8°13' North latitude and 35°30'-38°46' East longitude in South Western part of South, Nation, Nationalities and Peoples Regional State.

Sampling techniques: The study districts were purposively selected based on the distribution and potential of chicken population (exotic/or hybrid chicken breed and indigenous chicken) and presence of exotic/or hybrid chicken breed. Before the main survey was conducted, a preliminary assessment was made to identify the presence of exotic, hybrid and indigenous chicken breed in the study areas. From 24 districts of 3 Zones, 6 potential districts (2 districts from each Zone) were selected based on the information obtained from the Zonal livestock and fishery development offices. Accordingly, 18 rural *Kebeles* (3 *Kebeles* from each district) were purposively sampled based on chicken production potential. Then, a total of 384 households, having a minimum of 3 indigenous chicken and who received at least two exotic/or hybrid chicken in the last three years were randomly selected by using a stratified sampling techniques. The number of respondents per each rural *Kebele* was determined by proportionate sampling technique based on the household size of the sampled rural *Kebeles*.

Sample size determination: The required total number of respondents was determined using the formula by Cochran[13] for infinite population (infinite population $\geq$50,000):

$$n = \frac{\left(Z\frac{\alpha}{2}\right)^2 p(1-p)}{e^2} \qquad n = \frac{(1.96)^2\, 0.5(1-0.5)}{(0.05)^2} = 384$$

Where:

n = Required sample size

Z^2 = Abscissa of the normal curve that cuts off an area at the tails (1-α) (95% = 1.96)

e = Margin of error (e.g., ±0.05% margin of error for confidence level of 95%)

p = Degree of variability in the attributes being measured refers to the distribution of attribute in the population set to the most conservative sample size, p = 0.5 and q = 1-p = 0.5

n = $[(1.96)^2 \times (0.5) \times (0.5)]/(0.05)^2 = [3.8416x0.25]/(0.0025) = 0.9604/0.0025 = 384$ households

The numbers of respondents/single selected *Kebele* was determined by proportionate sampling technique as follows:

$$W = \left[\frac{A}{B}\right] \times n$$

Where:

A = Total number of households living per a single selected *Kebele* having a minimum of 3 indigenous and who received at least two exotic/or hybrid chickens

B = Total sum of households living in all selected sample *Kebeles* having a minimum of 3 indigenous and who received at least two exotic/or hybrid chicken

n = Total required calculated sample size

Method of data collection: Semi-structured questionnaires were used to collect qualitative and quantitative data from primary source which mainly comprised of households, Development agents and key informants. Before the commencement of the main survey, the questionnaires were pre-tested using sample households and some adjustments were made on specific contents. The interviews were conducted at farmer's house with the aid of Development agents those working in the selected rural *Kebeles*. An observation to physical facility of hybrid and indigenous chicken breed and open discussion with chicken farmers was also made. Secondary data was collected from written documents of livestock and fishery development offices of each districts and rural *Kebele*, books and journals.

Regarding the impacts of distributed hybrid chicken populations, the list of households who received hybrid chicken for the last 3 years were obtained from livestock and fishery resource offices and the information was collected through the "recalling methods" of the interviewed farmers with a pre-tested semi-structured questionnaire.

Statistical analysis: All collected data was analyzed by using Statistical Package for Social Science[14], version 17 for windows. The effects of zones on the proportion of each qualitative survey data was analyzed using frequency procedure of Chi-square (χ^2) test. Analysis of variance (ANOVA) was carried out to examine variance of the quantitative data collected. For qualitative factors, descriptive statistics was used. Standard error of mean (SE) was used while describing mean.

RESULTS AND DISCUSSION

Household characteristics in the study areas: The household characteristics of the respondents are presented in Table 1. From the total interviewed chicken owning farmers 67.2, 56.5 and 85.6% were females in Bench Maji, Kaffa and Sheka zones, respectively. Higher proportion of female respondents (69.5%) than males (30.5%) was observed. This indicates that female farmers are mainly involved in managing and caring of chickens in the study areas.

Table 1: Household characteristic of respondents in the study areas (n = 384)

Household characteristics	Bench Maji n = 128 (%)	Kaffa n = 131 (%)	Sheka n = 125 (%)	Overall n = 384 (%)	χ^2-test
Sex (%)					
Male	42 (321.8)	57 (43.5)	18 (14.4)	117 (30.5)	26.1**
Female	86 (67.2)	74 (56.5)	107 (85.6)	267 (69.5)	
Average age (years)	37[b]	40[b]	45[a]		40.7**
Educational level (%)					
Illiterate	17 (13.3)	18 (13.7)	26 (20.8)	61 (15.9)	53.9**
Read and write	2 (1.6)	27 (20.6)	10 (8.0)	39 (10.2)	
Primary first cycle (1-4)	21 (16.4)	28 (21.4)	35 (28.0)	84 (21.9)	
Primary second cycle (5-8)	46 (35.9)	34 (26)	43 (34.4)	123 (32)	
High school (9-12 and above)	42 (32.8)	23 (17.6)	11 (8.8)	76 (19.8)	
Diploma and above	NR	1 (0.8)	NR	1 (0.3)	
Average family size (number)	5	6	6	5.89	

NR: Not reported, **p<0.01, χ^2-test: Chi-square test, [a,b]Significantly different

Table 2: Indigenous chicken flock compositions in the study areas (n = 384, Mean±SE)

Flock composition	Bench Maji	Kaffa	Sheka	Mean±SE
Chicks	3.30±0.542[b]	3.94±0.210[a]	3.32±0.285[b]	3.54±0.188
Growers	3.59±0.187[a]	3.13±0.134[b]	2.64±0.156[c]	2.92±0.098
Layers	2.68±0.102[b]	3.50±0.080[a]	1.94±0.133[c]	2.81±0.070
Cocks	2.03±0.078[a]	1.97±0.041[b]	1.09±0.051[c]	1.81±0.040
Total	6.70±0.393[b]	8.76±0.290[a]	4.22±0.256[c]	6.61±0.206

Means with different superscript letters are significantly different (p<0.05), SE: Standard error of the mean, n: Number of households

Table 3: Hybrid chicken flock compositions in the study areas (n = 384, Mean±SE)

Flock composition	Bench Maji	Kaffa	Sheka	Mean±SE
Chicks	18.1±4.05[a]	3.75±0.48[b]	2.740±0.432[b]	8.39±1.897
Growers	7.26±0.87[a]	3.33±0.296[b]	3.256±0.497[b]	4.89±0.423
Layers	5.62±0.314[a]	3.82±0.173[b]	3.026±0.166[c]	4.18±0.144
Cocks	2.81±0.37[a]	2.05±0.113[b]	1.364±0.058[c]	2.10±0.132
Total	14.5±1.11[a]	6.97±0.295[b]	5.760±0.279[b]	9.09±0.440

Means with different superscript letters are significantly different (p<0.05), SE: Standard error of the mean, n: Number of households

Table 4: Reproductive and productive performance of indigenous chickens in the study areas (n = 384, Mean±SE)

Parameters	Bench Maji	Kaffa	Sheka	Overall mean
Age at first egg (months)	6.6±0.104[b]	7.02±0.024[a]	6.78±0.101[b]	6.8±0.063
Egg number/hen/clutch	13.6±0.44[b]	14±0.073[a]	13.5±0.732[b]	13.7±0.336
Clutch length/hen (days)	23±0.445[a]	21±0.073[b]	24±0.732[a]	22.7±0.328
Clutch number/hen/year	3.8±0.166[b]	4.3±0.01[a]	4.1±0.075[a]	4.1±0.023
Total egg number/hen/year	52±0.21	60±0.11	55±0.13	56±0.141
Eggs incubated/hen	10.5±0.073[a]	10±0.026[b]	10±0.094[b]	10.2±0.041
Number of chicks hatched	8.82±0.122[a]	6.38±0.120[c]	7.25±0.086[b]	7.48±0.082
Hatchability (%)	85	63.6	72.7	73.7
Number of chick survived	5.47±0.094[a]	4.39±0.050[b]	5.60±0.0964[a]	5.148±0.055
Survivability (%)	64.4	70.6	79	71.2

Means with different superscript letters are significantly different (p<0.05), SD: Standard deviation

The average age of respondents in the present study was 37, 40 and 45 years in Bench Maji, Kaffa and Sheka Zones, respectively. The educational level of respondents showed that about 35.9, 26 and 34.4% in Bench Maji, Kaffa and Sheka zones, respectively were attended the primary second school (5-8). This might be due to the fact that farmers in the study area who were able to keep improved chicken were aware about the benefit of keeping hybrid chicken populations.

Indigenous and hybrid chicken flock compositions: The average indigenous chicken flock size/household in Bench Maji, Kaffa and Sheka Zones was, 3.54, 2.92, 2.81 and 1.81 heads of chicks, growers, layers and cocks, respectively with the overall mean chicken flock size of 6.61 (Table 2). The largest proportions of chicken populations were reported from Kaffa Zone and which is significantly higher (p<0.05) than Bench Maji and Sheka Zones.

The average hybrid chicken flock size/household in Bench Maji, Kaffa and Sheka Zones was, 8.39,4.89, 4.18 and 2.1 heads of chicks, growers, layers and cocks, respectively with the overall mean Hybrid chicken flock size of 9.09 (Table 3). The largest proportions of Hybrid chicken breed were reported from Bench Maji Zone which is significantly higher (p<0.05) than Kaffa and Sheka Zones.

Reproductive and productive performance of indigenous chickens: The reproductive and productive performances of indigenous chickens are illustrated in Table 4. Age at first egg (months) was significantly longer (p<0.05) for chickens reared in Kaffa Zone (7.02 months) than Bench Maji (6.6 months) and Sheka (6.78 months) Zones.

Egg number/hen/clutch in the present study was 13.6, 14 and 13.5 eggs in Bench Maji, Kaffa and Sheka Zones, respectively. Eggs incubated per hen in Bench Maji, Kaffa and Sheka Zones was 10.5, 10 and 10, respectively. The hatchability percentages of chickens reared in Bench Maji Zones was significantly higher (p<0.05) than Kaffa and Sheka Zones. Zones had significant effect (p>0.05) on survivability of chicken. In Sheka Zone survivability percentage was significantly higher than Kaffa and Bench Maji Zone. In general, the average egg/year and clutch number/hen/year in the current study was 56 and 4.1, respectively.

Table 5: Chicken husbandry practices in the study areas (n = 384)

	Bench Maji		Kaffa		Sheka		Overall		
Parameters	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2-test
Management system									
Scavenging	9	70.3	95	72.5	93	74.4	278	72.4	0.53^{ns}
Semi-scavenging	38	29.7	36	27.5	32	25.6	106	27.6	
Housing system									
In the kitchen	72	56.2	49	37.4	52	41.6	173	45.1	22.6**
Together with family	26	20.3	58	44.3	56	44.4	140	36.5	
Separate houses	30	23.4	24	18.3	17	13.6	71	18.5	
Supplementary feeding									
Yes	112	87.5	122	93.1	119	95.2	353	92.0	5.44^{ns}
No	16	12.5	9	6.9	6	4.8	31	8.0	
Frequency of feeding									
Once a day	65	56.0	101	77.1	61	48.8	227	61.0	35.7**
Twice a day	19	16.4	16	12.2	43	34.4	78	21.0	
Three or more time a day	32	27.6	14	10.7	21	16.8	67	18.0	
Feed supplements (%)									
Maize	18	14.1	25	19.1	13	10.4	56	14.6	14.9^{ns}
Maize+sorghum	28	21.9	10	7.6	28	22.4	66	17.2	
Maize+sorghum+left over	49	38.3	56	42.7	48	38.4	153	39.8	
Maize+wheat+left over	33	25.8	40	30.5	36	28.8	109	28.4	

χ^2-test: Chi-square test, ns: Non-significant, **p<0.01

Table 6: Sources of hybrid chicken and type of hybrid breed received in the study areas

	Bench Maji		Kaffa		Sheka		Overall		
Attributes	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2-test
Source of hybrid chicken									
Bonga PPC	38	29.7	71	54.2	66	52.8	175	45.6	21.4**
Gubre PPC	56	43.8	37	28.2	42	33.6	135	35.2	
Private farm	19	14.8	12	9.2	8	6.4	39	10.2	
Local market	15	11.7	11	8.4	9	7.2	35	9.1	
Type of breed received									
Sasso	88	68.75	38	29.0	911	72.8	217	56.5	61.6**
Bovans brown	40	31.25	93	71.0	34	27.2	167	43.5	
Reason for selection of breed									
High in egg production	73	57.0	64	48.9	68	54.4	205	53.4	3.64^{ns}
Good in disease resistance	6	4.7	8	6.1	10	8.0	24	6.2	
Fits the local environment	10	7.8	13	9.9	7	5.6	30	7.8	
Fast in growth rate	39	30.5	46	35.1	40	32.0	125	32.6	

χ^2-test: Chi-square test, **p<0.01, PPC: Poultry production center, ns: Non-significant

Husbandry practices of chickens

Housing system, feed and feeding practices: Housing system significantly differed (p<0.05) across studied zones. As presented in Table 5, about 45.1% of households keep their chicken in the kitchen and 36.5% of them shared their main houses with their chicken and other farm animals and 18.5% provided separate house for their chickens.

Housing system significantly differed across the study zones. In the current study, supplementary feeding for chickens was provided across the study zones. About 92% of the study respondents provide supplementary feeds beside of scavenging. The type of supplement provided by the respondents were not significantly varied (p>0.05) across the study zones. The common types of supplements were Maize, Wheat, Sorghum and household left over. However, majorities of respondent's (39.8%) provide maize, sorghum and household left over (Table 5).

Hybrid chicken breeds production: Results pertaining to hybrid chicken breed were described in the Table 6. In this study the respondents commonly receive hybrid chicken from Bonga poultry production center (45.6%) and Gubre poultry production center (35.2%). However, the sources of hybrid chicken received by the households were significantly varied (p<0.01). Data pertaining to the type of hybrid chicken received by the respondents were Sasso and Bovan brown across the study zones, which is significantly differed across the study zones (p<0.01).

Table 7: Status of indigenous chicken populations in the study areas

	Bench Maji		Kaffa		Sheka		Overall		
Attributes	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2-test
Productivity of indigenous chicken									
Increasing	18	14.1	12	9.2	10	8.0	40	10.4	6.50^{ns}
Decreasing	70	54.7	61	46.6	68	54.4	199	51.8	
Stable	40	31.2	58	44.3	47	37.6	145	37.8	
Are they cross breeding with hybrid?									
Yes	26	20.3	39	29.8	36	28.8	101	26.3	3.60^{ns}
No	102	79.7	92	70.2	89	71.2	283	73.3	
Status of indigenous chicken (Trends)									
Increasing	17	13.3	13	9.9	12	9.6	42	10.9	8.90^{ns}
Decreasing	82	64.1	80	61.1	68	54.4	230	59.9	
Stable	29	22.7	38	29.0	45	36.0	112	29.2	

χ^2-test: Chi-square test, ns: Non-significant

Table 8: Effectiveness of hybrid chicken breed distribution in the study areas

	Bench Maji		Kaffa		Sheka		Overall		
Parameters	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2-test
Indicative variables									
High in egg production	32	25.0	40	30.5	35	28.0	107	27.9	24.2^{ns}
High in growth rate	42	32.8	28	21.4	30	24.0	100	26.0	
Survive better	2	1.6	8	6.1	3	2.4	13	3.4	
Better in disease resistance	11	8.6	9	6.9	5	4.0	25	6.5	
Highly demanded	25	19.5	20	15.3	30	24.0	75	19.5	
Sold in good price	14	10.9	18	13.7	9	7.2	41	10.7	
Not effective	2	1.6	8	6.1	13	10.4	23	6.0	

χ^2-test: Chi-square test, ns: Non-significant

In the current study the respondent's perception on the type of hybrid chicken breed production was due to high egg production (53.4%), fast in growth rate (32.6%), disease tolerance (6.2%) and adaptability to the existing environmental conditions (7.8%), across the study Zones. Selection of hybrid chicken breed had no significant ($p>0.05$) effect across the study Zones.

Perception of households towards indigenous chicken flocks: The present result (Table 7) pertaining to productivity of indigenous chicken was decreasing (51.8%) across the study areas. Even though, 37.8% of the respondents indicated productivity was stable. Due to introduction of hybrid chicken breed, the farmers' tendencies to rear and keep the indigenous chicken populations were significantly decreased (59.9%) across all study areas. The results relating to cross breeding of indigenous chicken with the distributed hybrid chicken indicated that the majorities of households (73.3%) were not interbreeding hybrid chicken with the indigenous chicken. This might be due to the fact that, the hybrid chicken grow fast and reach to market, they lay eggs early and the owners sell eggs collected from the hybrid chicken because of the high value of egg prices in the area.

Effectiveness of hybrid chicken breeds: The effectiveness of introduced hybrid chicken breed in the study area is presented in the Table 8. The result indicated that the effectiveness of hybrid chicken was described by indicative variables. Thus, the hybrid chickens were high in their egg production (27.9%), fast in their growth rate (26%) and highly demanded (19.5) by the communities were the main indicatives for the effectiveness of hybrid chickens.

Impacts of hybrid chicken breeds: The result pertaining to impacts of hybrid chicken breed introduction in the study area was presented in (Table 9). The result indicated that, the introduction of hybrid chicken breed in the study area were impacted by reduced production of indigenous chicken (35.4%), lead to gene dilution with the indigenous chicken (18.8%), compete to human food (15.1%) and cannibalism (13.8%).

Production constraints of chickens: In the present study feed shortage, disease and predators were the most important problem reported to be affecting chicken production and productivity in all study Zones accounting for 35.4, 34.4 and 30.2% across the study Zones as shown in Table 10. The type of predators commonly occurring in the study zones were

Table 9: Impacts of hybrid chicken distribution in the study areas

	Bench Maji		Kaffa		Sheka		Overall		
Traits	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2-test
Impacts hybrid over indigenous chicken									
Cannibalism	15	11.7	28	21.4	10	8.0	53	13.8	25.2*
Compete to human food	25	19.5	15	11.5	18	14.4	58	15.1	
Reduced production of indigenous chicken	35	27.3	42	32.1	59	47.2	136	35.4	
Leads to disease transmission to the indigenous environment	11	8.6	9	6.9	5	4.0	25	6.5	
Lead to gene dilution with the indigenous chicken	28	21.9	20	15.3	24	19.2	72	18.8	
Destruction of vegetables in the backyard	14	10.9	17	13.0	9	7.2	40	10.4	

χ^2-test: Chi-square test, *p<0.05

Table 10: Production constraints of chicken in the study areas

	Bench Maji		Kaffa		Sheka		Overall		
Parameters	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	χ^2-test
Production constraints (%)									
Disease	49	38.3	50	38.2	33	26.4	132	34.4	21.6**
Feed shortage	47	36.7	54	41.2	35	28.0	136	35.4	
Predators	32	25.0	27	20.6	57	45.6	116	30.2	
Types of predators (%)									
Chilfit (*Buteo jamaicensis*)	22	17.2	42	32.1	37	29.6	101	26.3	17.8**
Shelemetmat (*Helogale hirtula*)	5	3.9	4	3.1	6	4.8	15	3.9	
Shelemetmat (*Helogale hirtula*), *Chilfit* (*Buteo jamaicensis*) and theft	73	57.0	53	40.5	42	33.6	168	43.8	
Chilfit (*Buteo jamaicensis*) and *Aner* (*Leptailurus serval*)	28	22.0	32	24.4	40	32.0	100	26.0	

χ^2-test: Chi-square test, **p<0.01, names of predators are Amharic, the federal official working language of Ethiopia

significantly differed (p<0.05) across the different zones. The types of predators were *Chilfit* (*Buteo jamaicensis*), *Shelemetmat* (*Helogale hirtula*), *Aner* (*Leptailurus serval*) and *Yedurdimet* (*Feliscatus*).

Household characteristics in the study areas: In the present study the highest percentage of females (69.5%) was observed across the study zones, which was in a good agreement with the results of various scholars in the country[15-17]. The result on educational level obtained in the current study primary second cycle was (34.4%) which disagrees with the findings of different scholars in Ethiopia[11,15-17], where they find illiteracy was the major educational levels obtained across the study areas. The average family size in the present study (5.89) was in close agreement with the findings of various scholars[11,15,17]. Lower family sizes: 4.5 and 4.06 person/households was reported in the country[18,19]. From the present findings and the reports from various parts of the country, it is clear that, female respondents were the main to care and manage chickens than males. Hence, it is important to empower women's through better education as they are the most to contribute a significant role in the improvement of indigenous chicken production systems in the country. In line with this Halima *et al.*[11] also indicated that, educating women will improve the overall socio-economic status of the family and the society.

Indigenous and hybrid chicken flock compositions: The average result of indigenous chicken flock size/household in the current study (6.61) was lower than the reports of Yemane *et al.*[20], who reported 8.5 chickens/households in Hallaba districts of Southern Ethiopia. The number of chickens per households reported by Halima *et al.*[11] in Northwest Ethiopia (7.1), Melesse *et al.*[21] in Southern region (7.9) and Ayalew and Adane[18] in Amhara region (7.76) are also higher values than the present study. However, Morenda *et al.*[15] reported that the lower flock size per household (4.85) than the present study. These variations in flock size in different parts of the country might be due to the presence of seasonal outbreak of diseases, predators, feed resource availability, economic aspects of the community, environmental conditions and settlement pattern of the societies. Results pertaining to hybrid chicken flock size per household in the current study (9.09) higher than the indigenous chicken (6.61) which is in agreement with the reports of Getiso *et al.*[22], in Wolayita and Kambata Zone, SNNPR. Where the higher proportion of hybrid chicken breed flocks observed in the present study and others was an indication of strong desire for eggs production their access in the areas.

Reproductive and productive performance of indigenous chickens: Age at first egg of chickens in the current study (6.8 month) was in close agreement with the findings of

Negassa *et al.*[7], from the Southeastern Oromia Zone. Higher age at first egg of indigenous chickens was reported from various parts of the country by Melesse *et al.*[21], Yitbarek and Atalel[23] and Yemane *et al.*[20]. Low age at first egg was also reported from Northwest Ethiopia by Addisu *et al.*[24] and Zewdu *et al.*[19] with 5.6 and 5.2 months old, respectively. Different report on age of chickens at sexual maturity might be due to lack of supplementary feeds and exposure of chickens for high and low ambient temperatures, light intensity and outbreak of diseases.

The present finding with regard to egg production per clutch per hen, number of eggs incubated and number of chicks hatched differed from the results of various scholars Zewdu *et al.*[19], Yemane *et al.*[20] and Yitbarek and Zewudu[25]. However, it was in close agreement with the findings of other scholars in the country[18,24] and also was comparable with the reports of CSA[5]. Highest value of eggs/clutch/hen was reported from Eastern Gojam Zone[18,25], which was 17 and 9-15 eggs/clutch/hen, respectively. The clutch number/hen /year and total egg number/hen/year in the current study was comparable with the findings of Addisu *et al.*[24] which was 3.62 and 46, respectively. However, high values of clutch number and egg number per hen per year were also reported Zewdu *et al.*[19] and Yitbarek and Zewudu[25]. The management aspects of the household's chicken rearing might be the reason contributing for the observed variations in the production and reproduction traits of indigenous chickens in the country.

The average hatchability (73.7%) of chickens in the current study was comparable with the results of some scholars Yitbarek and Zewudu[25] and Bekele *et al.*[26]. However, higher hatchability percentages were reported by other researchers Tadele *et al.*[2], Negassa *et al.*[7] and Melesse *et al.*[21], in which the hatchability percentages were 79.1, 80.5 and 81.5%, respectively. Regarding the average survival rate of chickens in the present study (71.2%) was also higher than most of the findings[7,20,21,26], with the respective values of 58.3, 52.3, 62.7 and 66.5%. These variations in the productive performances of indigenous chickens might be due to seasonal outbreak of disease, predator attacks, poor nutrition and poor management, availability of scavenging feed resources and feed supplements.

Husbandry practices of chickens in the study area: In the present study the major management systems practiced by the study participants was scavenging (72.4%). This finding is in close agreement with the observations of different scholars in various parts of the country, where scavenging was the dominant type of chicken rearing systems in the country[19,20,25]. This management system might be due to the fact that chickens can best fits as they receive few inputs such as feed supplementation and health care for their survival, production and productivity.

In the study area, the majority of chickens at the night are mainly kept in the kitchen and main houses, which is also in agreement with the findings of different scholars in various parts of the country[11,15,24]. A study conducted in western Kenya indicated, similar scenario where majority of the households (73%) in the rural areas kept their chickens in the kitchen or in main houses[27]. The result relating to supplemental feeds in the study area are in line with the findings of different scholars in various parts of the country[18,19,24].

The result pertaining to productivity of indigenous chicken was decreasing (51.8%) across the study Zones. Even though, 37.8% of the respondents indicated productivity was stable. Due to introduction of hybrid chicken breed, the farmer's tendency to rear and keep the indigenous chicken populations were significantly decreased (59.9%) across the study Zones. The results relating to cross breeding of indigenous chicken with the distributed hybrid chicken indicated by the households showed majorities (73.3%) said the hybrid chicken were not interbreeding with the indigenous chicken. In line with this the estimated number of poultry by type and breed in Ethiopia in 2016/17 were 59,495,026 (100%), of which 54,053,925 (90.85%) indigenous chickens, 2,610,482 (4.39%) exotic and 2,830,619 (4.76%) hybrid chickens[5]. Whereas, the estimated number of poultry in 2017/8 were 60,042,295 (100%) of which 53,137,399 (88.5%) indigenous chickens, 3,750,011 (6.25%) exotic and 3,154,885 (5.25%) hybrid chickens[5]. These values indicated that the numbers of indigenous chickens are decreasing however, the numbers of exotic and hybrid chickens are increasing from time to time. This might be due to early maturity and high egg production of exotic and hybrid chickens as compared to indigenous chicken. This study was also in close agreement with the results of various scholars in the country[22,28,29].

In this study the respondents commonly receive hybrid chicken from Bonga poultry production center (45.6%) and Gubre poultry production center (35.2%). Data pertaining to the type of hybrid chicken received by the respondents were Sasso and Bovans brown across the study zones, which is significantly differed across the study Zones ($p<0.01$). This study was in close agreement with the findings of Getiso *et al.*[22], in which the types of hybrid chicken breeds reared by the study farmers were Sasso and Bovans brown breeds. Similarly, the sources were also in same scenario

with this scholar where Government Extension agents, non-government organization, purchasing from market, purchasing from cooperatives and private farms were the major sources of improved chicken in the studied areas.

Effectiveness of hybrid chicken breeds: In the present study the result pertaining to impact of hybrid chicken breed distribution was described by various variables such as high in their egg production (28%), fast in their growth rate (24%) and highly demanded (19.1%) by the communities were the main indicatives for the impact of hybrid chicken compared to indigenous chicken. This result was in close agreement with the early findings of scholars in the country[22,28,30]. It also in line with this Getiso *et al.*[22] described farmers in Southern, Nations Nationalities and Peoples regions are mainly producing hybrid chickens on the basis of traits of preference mainly on egg production, body size and meat production, scavenging ability, disease resistance and physical appearance, thus this is also in the same scenario with the present study. However, the perception of respondents towards producing hybrid chickens were dwindling due to the fact that their poor brooding ability, inadequate of alertness to predators, poor colour camouflage against predators and their short legs which are unsuitable for fast running. According to Melkamu *et al.*[28], in Ethiopia, the introduction of exotic breeds of chicken goes back to early 1950s. However, the contribution of exotic poultry to the Ethiopian economy is significantly lower than that of other African countries.

Impacts of hybrid chicken breeds: In the current study the introduction of hybrid chicken breed in the study area were impacted by various indicative variables such as, reduced production of indigenous chicken (35.4%), gene dilution with the indigenous chicken (18.8%), high competition with human food (15.1%) and cannibalism (13.8%). The past genetic improvement efforts of the Ethiopian village chicken via exotic chicken extension was impacted by lack of comprehensive poultry technology package extension to the end users[31]. The impact of this far extension effort couldn't change livelihood and meet the national poultry products demand of a human population that is growing at a rate of 2.9% annually[32].

Production constraints of chickens: The major constrains of chickens in the study districts were feed shortage, predators and diseases. This result was in agreement with the reports of Yitbarek and Atalel[23], Alem[33], Habte *et al.*[34] where predators were reported to be the major problems in indigenous chickens reared in various parts of the country. In the current study the types of diseases affecting chicken production were not included as farmers could not identify clearly the types of diseases affecting their chickens. However, the various types of predators were reported with the indigenous languages which are also reported in various parts of the country. The most challenging predators which has been reported in various parts of the country were Hawk, Genet, Wild cat, Wild Egyptian vulture and Honey[33,34]. Hence, the various types of predators observed in the current study and elsewhere might be due to the agro ecological suitability of the country for predators.

CONCLUSION AND RECOMMENDATIONS

In the current study the numbers of indigenous chickens are decreasing however, the number of exotic and hybrid chickens are increasing from time to time. This might be due to early maturity and high egg production of exotic and hybrid chickens as compare to Indigenous chicken. Scavenging was the dominant chicken management system by major housing in kitchen with the provision of supplementary feed mainly maize sorghum and household left over. The exotic/hybrid chickens were effective in terms of egg production potential, fast growth rate under good management practices in the study areas. The farmers indicated that in spite of their impact the hybrid chicken breeds have impacted on reduction of indigenous chicken breed population, which might lead to gene dilution, competition with human food crops at backyard and cannibalism. The major production constraints reported in the study areas were feed shortage, disease and predators, respectively. Therefore, it is crucial to keep and upgrade indigenous chicken breed which possess useful genetic potentials that could be improved through appropriate selection under scavenging management system. Eventually, the management practices should be improved in order to increase the productivity of chicken breed in the study areas.

SIGNIFICANCE STATEMENT

This study discovers the distribution of exotic chicken breeds in the local environments of South Western Ethiopia that can be beneficial for policy makers, researchers and livestock breeders. It will help the researcher to uncover the critical areas of distributed exotic/hybrid chicken breed impacts on the indigenous chicken populations that many

researchers were not able to explore. Thus, a new theory on future directions of imported exotic/hybrid chicken breed may be arrived at.

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