Journal of Innovative Agriculture

Research Article
DOI: https://doi.org/10.37446/jinagri/rsa/10.4.2023.1-9

Adaptation and performance evaluation of koekoek chicken breed under agro-pastoral management condition of South-Omo Zone, Ethiopia

Elias Gonta[1*], **Demerew Getaneh**[2]

[1]Poultry researcher, Jinka Agricultural Research Center, P.O. Box 96, Jinka, Ethiopia.
[2]Animal breeding researcher, Jinka Agricultural Research Center, P.O. Box 96, Jinka, Ethiopia.

Received: 03 August 2023
Accepted: 15 November 2023
Published: 31 December 2023

***Correspondence**
Elias Gonta
eliasgonta@gmail.com

Volume: 10
Issue: 4
Pages: 1- 9

Lack of best-performing breed was the main chicken production problem, & keeping improved breeds boosts chicken meat and egg production. An experiment targeted with adaptation & performance evaluation of the Koekoek breed was conducted in the Hammer district. A purposive sampling method was used to select kebele & households. After the provision of training the poultry house was constructed. Vaccination was provided for economically important diseases & 21 pullet chickens were distributed to each 25 households. The commercial feed was used initially, then home-prepared feed in addition to scavenging. The trial chickens were managed for 18 months. Mortality (19.8%) was the collective effect of predator, disease, stress, & injury with overall survival of 80.2%. The average body weight was 1.95 & 1.33 Kg for males & females at the age of 175 & 208 days respectively. The average yearly egg production & egg weight was 145 & 47.2 gram, respectively. The breed was preferred due to its egg production, body weight, scavenging, & less disease exposure. However, the veterinary vaccines, awareness gap of keepers, absence of breed, & feed shortage were the main factors. So, the breed showed good adaptation, performed well & highly preferred defending the hindering factors. Therefore, there should be strong awareness creation, the accessibility of the breed should be secured by extension, & feed trial experiments should be recommended to know the full genomic potential of the breed.

Key words: *agro-pastoralist, breed, chicken, dual-purpose, koekoek*

INTRODUCTION

The chicken number in our country was 59.5 million; of which only 2.6 million were improved breeds with a relative contribution of 4.39% (CSA, 2016). As the report (CSA, 2017) indicated, from an estimated 60.04 million chickens only 6.25% were exotic breeds, & the contribution of the local ecotype was about 88.5%. Although the country has many chickens' numbers, the number of eggs/clutch/hen of the local ecotype was 10.12 eggs with an average day of 14.7 (Gonta Gobena & Urge, 2021). However, that of the Koekoek breed was 154 eggs/year/hen with an average egg weight of 47.078 grams for Debub Ari & Bena-Tsemay districts of South Omo zone, Ethiopia, (Gobena, 2020). Additionally, the Koekoek dual-purpose chickens showed good performance & adaptation under the agro-pastoralist condition of the Asayta district (Hassen, 2019) & the Bovan Brown chicken production under the low-land area was feasible in terms of egg production to generate income & enhance nutrition (Begna et al., 2023). The lack of improved & early-maturing chicken breeds was a main constraint for Ethiopian chicken producers (Goraga et al., 2016). The same author also reported that varying climate-based trials of improved breed boost the productivity of egg & chicken meat, then the living standards of chicken-rearing households. Furthermore, the lack of best-performing improved breeds was one of the main problems of chicken egg & meat production in the pastoralist & agro-pastoralist areas & it might be one cause of malnutrition in the areas. Chicken production plays a significant economic, social, cultural, & nutritional role for countries with low income (Urgesa, 2023). Rearing the improved chicken breeds & advancing the farmer's attitude through training & awareness creation can considerably improve chicken meat & egg productivity. Furthermore, the production of improved breeds also allows for gaining income for the household females & children in addition to sustaining the cheap animal protein. Formerly, the productive performance of highly adapting & producing dual-purpose chicken breeds such as Koekoek was not evaluated in pastoralist & crop-livestock farming areas of the south-Omo zone. Additionally, the improved breed production constraints & the agro-pastoralist perception & preference regarding the Koekoek breed were also not studied. So, the absence of improved (Koekoek) chicken breeds in the area & the presence of best-performing improved chicken breeds that survive the different agro-ecology of our country provide room for adaptation & evaluation of improved breeds such as the Koekoek. So, this study was targeted at the adaptation & performance evaluation of the koekoek dual-purpose breed, to see the agro-pastoral perception regarding the breed & identify the chicken production constraints in the area.

MATERIALS AND METHODS

Description of the study area

The trial was conducted in the Hammer district of the South Omo Zone, Ethiopia (Table 1).

Table 1. Description of the study area

Parameters	Magnitude with unit
Distance from the national capital (Addis Ababa)	755 Kilometer, south-east
Distance from the regional capital (Hawassa)	564 Kilometer, south-east
Distance from zonal capital (Jinka)	100 Kilometer, south-east
Population size	68,765
Area coverage	696,058 hectare
Geographic position	40.50' - 50.47' N L & 360.15'- 360.90' E L
Altitude	371 - 2084
Temperature	29ºC–38ºC
Rainfall	764 mill meters
Climate	54.45% arid, 37.5% semi-arid, 8% midland, & 0.05% Desert type

Source; (Adicha & Mengistu,2022). NL = North Latitude & EL = East Longitude

The site and household selection

The purposive sampling method was used to select the study kebele & participant households based on their back chicken-keeping practice, ability to manage experimental chickens, willingness to cover the package cost

of feed, ability to record the data & willingness to construct chicken houses. Based on these a total of 25 agro-pastoralists were selected with the help of extension workers & participated in this adaptation & evaluation trial.

Distribution of the experimental chicken and management

A total of 525 pullet Koekoek dual-purpose chicken breed was purchased from Debre private poultry farm, in Ethiopia. Accordingly, 21 pullet Koekoek chickens of mixed sex were provided to each agro-pastoralist & managed under the existing agro-pastoralist conditions.

Feeding and disease prevention

Concentrate pullet feed was used for the first two months, then, the agro-pastoralists prepared chicken feed from locally available feeding materials like corn, sunflower, sorghum, & miller grounded waste. Additionally, the chickens used house wastes, forage, flying insects, & worms as basal feed while scavenging around the garden. Routine medication & health follow-ups were done by the researchers & animal health experts. The vaccination was provided against economically important poultry diseases based on the schedule of the National Veterinary Institute for dual-purpose chickens. Finally, the technical backup, follow-up & data recording were taken in 15-day intervals, but the health follow-up and egg data recording were gone daily.

Training & awareness creation

The training was provided to development agents, chicken keepers & animal health experts about chicken management such as feed and feeding, housing provision, vaccination & medication, waste management, egg handling & data recording.

Data collection

The trial was undergone for eighteen months. The data collection format was prepared & the follow-up and monitoring was done in fifteen-day intervals, but the health follow-up & egg data was recorded daily. The data of mortality, survived, case of mortality, body weight of male & female, age of sexual maturity of male & female, number of eggs produced per hen per year, egg weight, production cost, & income from each household were collected. Finally, at the stage of the start of egg laying the agro-pastoralist perception and preference data regarding the breed was recorded during the agro-pastoralist's field day.

Data Analysis

Descriptive statistics such as the mean & percentage of the collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version, 2020.

RESULTS AND DISCUSSION

Survival and Mortality

The average survival, &mortality are presented in (Table 2), 80.2% of chickens survived & reached the age of sexual maturity under the existing management. The survival, mortality, & causes of mortality were different among households due to the management & awareness differences among households. The highest mortality was recorded due to predatory wild animals & birds, attributed to the presence of large amounts of bushes & forests for animal browsing & these shrubs & forests make better ground for predatory animals & bird hiding.

Table 2. Table of distributed, survival, mortality, numbers of hens, and performance of chickens

Code	distributed	Survived	Died	BW at the age of sexual maturity		Age of sexual maturity		No of hens	No of egg/h/y	Egg w
				Male	Female	Male	Female			
CK1	21	16	5	2088 g	1195 g	180 days	210 days	8	149	47.0 g
CK2	21	18	3	2015 g	1275 g	170 days	185 days	8	138	49.0 g
CK3	21	16	5	2118 g	1160 g	170 days	170 days	6	125	45.0 g
CK4	21	18	3	2178 g	1225 g	160 days	220 days	7	140	46.7 g

CK5	21	18	3	2055 g	1225 g	190 days	190 days	8	163	41.7 g
CK6	21	19	2	1565 g	1270 g	190 days	178 days	7	150	50.0 g
CK7	21	18	3	1976 g	1340 g	160 days	240 days	7	144	47.4 g
CK8	21	16	5	1580 g	1150 g	164 days	225 days	7	139	42.8 g
CK9	21	17	4	1360 g	1220 g	190 days	195 days	6	150	51.0 g
CK10	21	17	4	1655 g	1420 g	178 days	178 days	8	151	48.5 g
CK11	21	16	5	2310 g	1840 g	150 days	195 days	8	131	47.0 g
CK12	21	17	4	2315 g	1620 g	160 days	230 days	9	133	43.0 g
CK13	21	15	6	2015 g	1470 g	172 days	224 days	8	137	44.5 g
CK14	21	16	5	1740 g	1400 g	180 days	175 days	10	143	40.0 g
CK15	21	16	5	2020 g	1185 g	160 days	232 days	8	159	53.0 g
CK16	21	18	3	1970 g	1190 g	165 days	215 days	10	148	48.0 g
CK17	21	17	4	2100 g	1288 g	176 days	245 days	8	150	46.0 g
CK18	21	16	5	2050 g	1370 g	190 days	198 days	7	150	50.0 g
CK19	21	17	4	2105 g	1410 g	166 days	218 days	7	143	51.0 g
CK20	21	18	3	2070 g	1520 g	184 days	200 days	10	144	54.0 g
CK21	21	17	4	1980 g	1440 g	190 days	241 days	6	150	43.0 g
CK22	21	18	3	1760 g	1320 g	200 days	244 days	9	147	48.6 g
CK23	21	16	5	1690 g	1170 g	195 days	176 days	8	156	47.0 g
CK24	21	17	4	2050 g	1180 g	160 days	237 days	9	138	49.5 g
CK25	21	14	7	1920 g	1240 g	175 days	183 days	6	148	46.9 g
Total	525	421	104	48.8 Kg	33.3 Kg	4375	5200	200	3625	1180 g
Av.	21	16.8	4.2	1.95 Kg	1.33 Kg	175 days	208 days	8	145	47.2 g
%		80.2	19.8							

Av = average, BW = body weight, Ck = chicken keeper, h = hen, Kg = kilo gram, g = gram, No = number, w = weight, & y = year. Values in the table represent the number of distributed, survived, and dead chickens in addition to their body weight, age of sexual maturity, number of egg-laying chickens, number of egg & egg weights.

The mortality due to stress (17.3%) in the 1st week happened due to the far-ness of the chicken breeding center from the experimental site. Mortality due to disease was not this much expected; this is one indication of adaptation of the breed & invites the further demonstration of the breed in large amounts. In line with this result, a similar survival value was reported by Getiso et al. (2016) & Hailemariam et al. (2018); the on-farm survival value of the koekoek chicken breed was 79.8% & 78.18% for Areka area & Mehoni area, respectively.

Body Weight and age of sexual maturity

The average body weight at the age of sexual maturity is presented in (Table 2). The average body weight of the Koekoek female chicken breed at the age of sexual maturity (208 days) was 1.33 Kg under agro-pastoralist management condition. A slightly higher body weight value was reported than Getiso et al. (2016), Biratu & Hailu (2016), & Gobena (2020); the average body weight of the female Koekoek breed at the age of sexual maturity was 1.1, 1.03, & 1.213 Kg, respectively, might be due to the management variation & kinds of feed that the chicken keepers used. The average body weight of the Male Koekoek chicken breed at the age of first mating (175 days) was 1.95 Kg. But, Hassen (2019) reported a little higher body weight value; the average body weight of Koekoek Male chickens at the age of 20 weeks was 2.23 kg, Gobena (2020) & Getiso et al. (2016) reported a little lower value; the average body weight of Koekoek cocks at the age of sexual maturity was 1.404 & 1.5 Kg respectively, & this might be due to feed & feeding differences among the sites.

Due to the shortage & quality of supplemental feed in the district, the female chickens showed late age of sexual maturity (208 days); shows that feed is the main factor that hinders chicken adoption & productivity, & securing the supplemental feed facilitates the fast age of sexual maturity, adoption, & productivity. The age at first egg laying was different among households (170–244 days), due to the difference in feeding, & feed type among households. Late age of sexual maturity was recorded than Hassen (2019) for the Asayta district; the average age of first laying was 24.5 weeks, Getiso et al. (2016) for the Wolaita area; 142 days, Tadesse (2012); 153 days for age for the sexual maturity of female koekoek, & this difference was might be due to agro-ecologic difference & quality of feed after the first two months.

In addition, the average age of sexual maturity of male & female koekoek chicken breeds was different between & within households, in which the male koekoeks showed a faster age of sexual maturity than the females; the

average age of sexual maturity of male & female Koekoek chickens was 175 & 208 days respectively, due to the genetic differences among the two sexes. Differently, Belay et al. (2018) reported the same age of sexual maturity for both sexes; the average age of sexual maturity for both male & female koekoek chickens was 6 months, due to the agro-ecological differences between the two sites.

Egg Production and Egg Weight

The average number of egg per hen per year, & the average egg weight of the koekoek dual-purpose chicken breed is presented in (Table 2). The koekoek dual-purpose chicken breed laid 145 eggs per hen per year with a relative egg weight of 47.2 grams under the agro-pastoralist existing condition. Similarly, Gobena (2020) & Hailemariam et al. (2018) stated that the average egg production of the Koekoek chicken breed was 154 eggs with a relative egg weight of 47.078 grams & the average yearly egg production of the same breed was 156 eggs per hen with a relative egg weight of 40.3 gram, respectively. But Abadi et al. (2020) reported some higher value than the current study; the average yearly egg production potential of the koekoek breed was 176 eggs per hen with a relative egg weight of 45.33 grams, which might be due to the chicken keeper's awareness & farming system, i.e., the chicken keepers were agro-pastoralists in the case of current study whereas farmers in the case of the former study.

Agro-pastoralists preference

The agro-pastoralist preference & perception of koekoek dual-purpose chicken are presented in (Table 3). As the agro-pastoralists mentioned the Koekoek dual-purpose chicken breed was preferred due to its feather color, egg production, egg hatchability, less cannibalism, & body weight at the age of sexual maturity as compared to local ecotypes.

Table 3. Agro-pastoralists perception regarding the breed (N=25)

Nº.	Parameters (attributes)	Level of preference			
		Poor/No	Good	Very good	Overall (%)
1	Breed color	-	-	25(100)	25(100)
2	Scavenging behavior	-	15(60)	10(40)	25(100)
3	Disease resistance	-	15(60)	10(40)	25(100)
4	Response to disease/recovery	-	13(52)	12(48)	25(100)
5	Brooding behavior	25(100)	-	-	25(100)
6	Response to predatory animals	25(100)	-	-	25(100)
7	Cannibalism	-	-	25(100)	25(100)
8	Egg production	-	-	25(100)	25(100)
9	Egg hatchability	-	-	25(100)	25(100)
10	Body weight	-	-	25(100)	25(100)

N = numbers of agro-pastoralists interviewed about preference of breed. Values in the table represent the agro-pastoralist's response regarding breed preference.

As agro-pastoralists reacted during the farmer's field day the scavenging behavior, disease resistance, & disease recovery of the breed was better than other improved breeds, but the agro-pastoralists worried about the absence of mothering ability & intelligence to escape predators compared to the indigenous breed. As the agro-pastoralists stated there were no cultural and religious taboos that limited the distribution of the breed (Koekoek) & also there was no challenge regarding the breed's color.

Partial budget analysis

The partial budget analysis of the koekoek dual-purpose chicken is presented in (Table 4). This partial budget analysis was based on the consideration of the change in the total variable cost (ΔTVC), total return (ΔTR), & net income (ΔNI).

Table 4. Partial budget analysis (in Ethiopian birr)

	Cost				Income				
Code	**Chick cost**	**Feed cost**	**Medication cost**	**TVC**	**Egg sale**	**Cock sale**	**Hen sale**	**TR**	**Profit**

CK1	3150	5000	500	8650	7735	4000	2400	14135	5485
CK 2	3150	5500	500	9150	7183	5000	2400	14583	5433
CK 3	3150	4500	500	8150	4875	5500	1800	12175	4025
CK 4	3150	5500	500	9150	6370	6050	2100	14520	5370
CK 5	3150	5500	500	9150	8400	5500	2400	16300	7150
CK 6	3150	6000	500	9650	6825	6600	2100	15525	5875
CK 7	3150	5500	500	9150	6559	5500	2100	14159	5009
CK 8	3150	4500	500	8150	6305	4950	2100	13355	5205
CK 9	3150	4700	500	8350	5850	6050	1800	13700	5350
CK10	3150	4500	500	8150	7865	4950	2400	17015	8865
CK11	3150	4500	500	8150	6825	4400	2400	13625	5475
CK12	3150	4800	500	8450	7800	4000	2700	14500	6050
CK13	3150	4000	500	7650	7137	3850	2400	13387	5737
CK14	3150	4500	500	8150	9334	3300	3000	15634	7484
CK15	3150	4800	500	8450	8255	4400	2400	15055	6605
CK16	3150	5200	500	8850	9653	4400	3000	17053	8203
CK17	3150	5000	500	8650	7800	4950	2400	15150	6500
CK18	3150	4000	500	7650	6825	4950	2100	13875	6225
CK19	3150	4800	500	8450	6500	5000	2100	13600	5150
CK20	3150	5500	500	9150	9380	4400	3000	16780	7630
CK21	3150	5000	500	8650	5850	6050	1800	13700	5050
CK22	3150	5000	500	8650	8580	4950	2700	16230	7580
CK23	3150	4800	500	8450	8125	4400	2400	14925	6475
CK24	3150	5000	500	8650	8080	4400	2700	15180	6530
CK25	3150	4000	500	7650	5785	4400	1800	11985	4335
Average				213350				366146	152796
Yearly income/household				8534				14646	6112

Ck = chicken keeper, TVC = total variable cost, TR = total return, NI = net income, & Δ = change. The values in the table represent the amount of the respective variable partial budget.

The change in the total variable cost (ΔTVC) includes the cost of chicken purchase, feed purchase, & cost of medication. The change in total return (ΔTR) includes the income from the sale of eggs, sale of cock, & sale of spent & laying hen. The change in the net income (ΔNI) was the difference between the change in total return (ΔTR) & change in total variable cost (ΔTVC).

Therefore, the change in the total return (ΔTR) was 14646 Ethiopian birr; whereas, the change in the total variable cost (ΔTVC) was 8534 Ethiopian birr. So the change in net income (ΔNI) was calculated as the difference between the changes in the total return (ΔTR) & the total variable cost (ΔTVC).

ΔNI = ΔTR – ΔTVC
ΔNI = 14646 – 8534
ΔNI = 6112 Ethiopian birr

However there was a difference in the changes in total return (ΔTR) between agro-pastoralists due to the variability of change in total variable cost (ΔTVC) & income level, the average yearly income of each agro-pastoralist was 6112 Ethiopian birr.

Challenges & opportunities

The shortage of chicken feed, drought, absence of infrastructure, lack of access to veterinary drugs/vaccines, predators, awareness gap of agro-pastoralists, & market problems were some of the challenges. Directly and indirectly, these constraints decreased the number of chickens surviving, exposure to disease, and retarded the chickens not to express their genomic potential. The newly emerging agricultural farming system & irrigation opportunities, human power & merchants flow from the central area were some of the opportunities to expand chicken production in the district.

CONCLUSION

The Koekoek dual-purpose chicken breed showed better survival (80.2%) & satisfactory production of eggs (145), body weight (1.33 Kg for females & 1.95 Kg for males) at the age of sexual maturity & medium-sized eggs (47.2 g). The low egg productivity was recorded than the full genomic potential of the breed for egg production & the number of eggs per hen per year was not comparable with the Koekoek breed that rears under intensive management. The breed was highly preferred in the area due to its productivity with weak supplementation, survival, fast age of sexual maturity, scavenging ability, feather color, disease resistance & egg hatchability. However, the agro-pastoralists worried about the absence of broadness, intelligence of the breed to escape the predators, feed problems, & the absence of breed source in addition to the agro-pastoralists' awareness gap to manage the improved breeds. Therefore, there should be awareness creation for agro-pastoralists before the start of the trial, the accessibility of the breed should be secured by extension to sustain the breed distribution in the area & the feed trial experiment should be conducted to compare the breed productivity under agro-pastoralist and intensive management condition.

ABBREVIATIONS

BW = Body Weight, Ck = Chicken keeper, CSA = Central Statistical Agency, g = gram, h = hen, Kg = Kilo gram, NI = Net Income, No = Number, SPSS = Statistical Package for Social Science, TR = Total Return, TVC = Total Variable Cost, w = weight, and y = year.

ACKNOWLEDGMENTS

The authors would like to thank the Low Land Resilience Project (LLRP) for logistics support. The authors also express their great appreciation to Hammer district Livestock extension experts especially “Berger” (DA), Pastoralists, & agro-pastorals who were involved in this research trial.

AUTHOR CONTRIBUTIONS

Mr. Elias Gonta wrote the entire manuscript in addition to conducting the research & data collection. Mr. Demerew Getaneh was involved in proposal development, & paper editions.

COMPETING INTERESTS

The authors declare that there is no conflict of interest & the manuscript has not been submitted for publication in other journals.

ETHICS APPROVAL

Not applicable

REFERENCES

Abadi, T., Gebretsadik, D., Gebremedhin, K., Tsigab, T., Zenebe, M., & Desta, D. (2020). On-farm Evaluation and Demonstration of Koekoek chicken under farmers conditions in Northwestern Tigray, Ethiopia. *International Journal of Veterinary Science and Research*, *6*(1), 064-067. https://www.peertechzpublications.org/articles/IJVSR-6-156.php.

Adicha, A., & Mengistu, B. (2022). Determinants of Agro-pastoral households’ diversification of income in Hamer District, South OMO Zone, Southern Ethiopia. *Journal of Agriculture and Aquaculture*, *4*(4).

Begna, R., Masho, W., Wondimu, W., Tilahun, Y., Bekele, T., Tadesse, B., & Negash, H. (2023). Participatory evaluation and demonstration of productive performance of Bovans Brown chicken under village production system in Menit Shasha Woreda, West Omo Zone, Ethiopia. *The Scientific Temper, 14*(3), 799–805. https://doi.org/10.58414/SCIENTIFICTEMPER.2023.14.3.36.

Belay, S., Resom, M., Yemane, H., & Amare, H. (2018). Production performance evaluation of koekoek chicken under farmer management practice in Tigray region, northern Ethiopia. *International Journal of Livestock Production, 9*, 232-237. https://doi.org/10.5897/IJLP2017.0436.

Biratu, K., & Haile, S. (2016). Demonstration and performance evaluation of "potchefstroom koekoek" chicken package at Jimma zone, South Western Ethiopia. *Journal of Biology, Agriculture and Healthcare*, *6*(15), 53-58.

Central Statistical Agency (CSA). (2016). *Agricultural sample survey: Report on livestock and livestock characteristics (private peasant holdings), volume II*. Federal Democratic Republic of Ethiopia, Central Statistical Agency. Addis Ababa, Ethiopia.

Central Statistical Agency (CSA). (2017). *Agricultural sample survey: Report on livestock and livestock characteristics (private peasant holdings), volume II* (pp. 9–12). Addis Ababa, Ethiopia.

Getiso, A., Yilma, M., Mekonnen, M., Jimma, A., Asrat, M., Tera, A., & Dako, E. (2016). Demonstration and Evaluation of Dual Purpose Chicken "Potchefstroom Koekoek" Packages at Areka areas, SNNPR, Ethiopia. https://digitalcommons.unl.edu/wffdocs/52.

Gobena, E. G. (2020). Adaptation and performance evaluation of Potchefstroom Koekoek chicken breeds under farmer's management practice in Debub Ari and Bena-Tsemay districts of South Omo Zone, Ethiopia. Agricultural and Veterinary Sciences, 19.

Gonta Gobena E., & Urge, P. (2021). Assessment of Smallholder Chicken Production Practices and Evaluation of Local Feed Resources in Two Districts of South Omo Zone, Ethiopia (Doctoral dissertation, Haramaya University).

Goraga, Z., Caron, L., Wilbert, C., & Brockmann, G. A. (2016). Characterization of village chicken production systems and challenges across agro-climatic zones in Ethiopia. *International Journal of Livestock Production, 7*(11), 94–105. https://doi.org/10.5897/IJLP2016.0320.

Hailemariam, A., Taye, A., Miglas, H., Edea, C., Amare, A., Habte, T., ... & Ibrahim, D. (2018). Evaluation and Demonstration of Potchefstroom Koekoek Chicken in and Around Mehoni areas of Southern Tigray Zone, Ethiopia. *Global Journal of Science Frontier Research: D Agriculture and Veterinary*, *18*(3).

Hassen, A. S. (2019). Demonstration and performance evaluation of dual-purpose chicken "Potchefstroom Koekoek" under agro-pastoral management conditions at Asayta districts of Afar regional state in Ethiopia. International Journal of Veterinary Science Research, 5(1), 019-024. https://dx.doi.org/10.17352/ijvsr.000036.

SPSS Inc. (2020). *Statistical Package for the Social Sciences (SPSS) for Windows* (Version 16.0) [Computer software]. Chicago, IL: SPSS Inc.

Tadesse, D. T. (2012). Management practices, productive performances, and egg quality traits of exotic chickens under village production system in east Shewa, Ethiopia (Doctoral dissertation, Addis Ababa University).

Urgesa, L. (2023). Review on Poultry Production System, Trends and Development Strategies in Ethiopia. Journal of Aquaculture & Livestock Production. SRC/JALP-138. DOI: doi. org/10.47363/JALP/2023 (4), 125, 2-5.