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Adaptation and Performance Evaluation of Layer (Bovan Brown) Chicken Breed in Peri-Urban Areas of Agro-Pastoralist, South Omo Zone, Ethiopia

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Abstract

An experiment targeted the adaptation and performance evaluation of the Bovan Brown chicken breed in peri-urban areas of Agro-pastoralist was conducted in the Malle district. One kebele and 25 households were selected purposively. Training was provided and 21 pullet chickens were distributed to each household. Vaccination was given for the common poultry diseases. The commercial feed was used for the first two months, and then home-prepared feed in addition to kitchen refusal, garden forages, insects, and worms. Mortality was the collective effect of disease, stress, predators, and injury. The average body weight of the breed was 1.5 Kg with an average age of sexual maturity of 6 months. On average the breed laid 237 eggs per hen per year with a relative egg weight of 48, 51, 53, and 57 g at 5%, 10%, 50%, and 95% lay periods, respectively. The breed was preferred due to its survival, egg production, feed conversion ability, and fast age of sexual maturity with some constraints such as feed shortage, absence of the breed, veterinary drugs, and vaccines in the district. The “Bovan Brown” breed was adapted, performed well, and was preferred by the users with the limitation of chicken feed and the awareness gap of keepers. Therefore, the chicken keepers should be trained for the preparation of the layers feed, especially, protein sources, and the distribution of the breed should be limited to urban, per-urban, and trained keepers with access to the road to buy inputs and sale outputs.

Keywords: *Agro-pastoralist, Bovan Brown, Breed, Chicken, Commercial, and Layer*

Introduction

The total of 50.5 million chickens in Ethiopia, 81.71, 7.43, and 10.86% were indigenous, exotic, and hybrid chickens, respectively [1]. The South Nation Nationalities Peoples region covers 7.3 million (5.8 million local, 1.1 million hybrid, and 3.65 thousand exotic types), and the South Omo Zone comprises only 3.47 thousand chickens (2.63 thousand local, 83 thousand hybrid and newly distributing exotic types).

Compared to other livestock production, Chicken production requires minimum land and capital for people with weak economic backgrounds [2]. It also plays a vital role in socio-economic inclusion, poverty lessening, and sustainable income provision for unemployed job-seeker groups [3]. Although the country has many numbers of chicken populations, the average number of eggs produced per year in Ethiopia is about 317 million [1]. As the same author reported, the average number of eggs laid per local, hybrid, and improved breeds in Ethiopia was about 13, 51, and 120 eggs, respectively.

The low egg production of the country might be due to the cumulative effect of more numbers of local breeds and their low productivity, backyard production system, weak access to drugs, and feed shortage. Similarly, slow growth, late sexual maturity, and low egg production are some of the determinant characteristics of the local breed [4]. In line with [5], stated that the genetic potential that attributed to the variation of productivity between local and improved breeds was enforcing the distribution of exotic breeds and replacing local breeds.

Like the other parts of Ethiopia, the chicken production of the South Omo zone is affected by the absence of improved chicken breeds, especially layer breeds. There was limited production of chicken eggs in the South Omo Zone generally and Malle district particularly due to the absence of best-laying, early-maturing breeds, and other production constraints in the area. Previously no scientific trial was conducted regarding the layer breeds adaptation and performance evaluation, particularly the “Bovan Brown” breed. In addition, the preference of chicken keepers and constraints of layer breed production were not evaluated. So, the gap and opportunity to solve the gap was invited to conduct the adaptation and performance evaluation trial. Therefore, this study was targeted with the demonstration, performance evaluation, perception evaluation of chicken keepers, and identification of challenges and opportunities of the “Bovan Brown” chicken breed in the peri-urban areas of the Malle district.

Materials and Method

Description of the study area

The study was conducted in the Malle districts of the South-Omo zone. Astronomically it is located between 4085'-5067' North latitude and 35075'-36023' East longitude with a total land area of 1,432 km^2. The altitude of the district is situated between 600-1500 mean above sea level with a relative annual temperature of 18-35ºc. Its agroecology is comprised of 15% midland and 85% lowland, with an annual rainfall of 800-1200 mm. The dominant crops that are being grown in the district are maize, sorghum, finger millet, ‘Teff’, and sunflower. The estimated human population of the district was 97,339 with 67.9 people per sq. km, according to the South Omo Zone Finance and Economy Development Department [6].

The site and household selection

The study kebele and households were selected purposively based on the chicken keeper's back chicken-keeping practice, and willingness to manage chickens and construct chicken houses. Based on the criteria a total of 25 households were selected and participated in this experiment.

Distribution of the experimental chicken and Management

A total of 525 pullets "Bovan Brown" layer breed were purchased from Debre-Zeit, Ethiopia, and were distributed to each participant household.

Feeding and Disease Prevention

For the first two months concentrate pullet feed was used then the chicken keepers prepared supplementary feed from locally available feeding resources like maize, sunflower, sorghum, salt, and miller feed refusals. As a basal feed chickens used kitchen refusals, forage, flying insects, and worms. The feeder, drinker, and poultry house construction materials were contributed by the chicken keepers, but experimental chickens were contributed by the research center. Routine health follow-ups were undertaken by livestock health experts and vaccination was provided against common poultry diseases.

Training and awareness creation

Training was given to agro-pastoralists, animal health experts, and development agents about feeding, house provision, vaccination, health, egg handling, and data recording. The data collection format was distributed to each household and development agent. Finally, the technical backup, data collection, monitoring, and evaluation were taken by the researchers.

Data collection

The data such as survival, mortality, causes of mortality, body weight, age at first egg laying, number of eggs/hen/years, Egg weight, variable cost, and income were collected.

Data analysis

The mean and percentage of the collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version [7].

Results and Discussions

Survival and Mortality

The average survival, mortality, and causes of mortality of chickens are presented in (Table 1). The average survival and mortality of the “Bovan Brown” commercial breed in peri-urban areas of the Malle district were 93.1 and 6.9%, respectively. The overall mortality in general and mortality due to disease was low; attributed due to the cumulative effect of the chicken’s adaptation, vaccination package, and chicken keeper’s awareness to protect from exposure.

A more promising result was recorded and shows that the per-urban areas were better grounds for commercial layer breeds if there was no other hindering factor like the feed shortage and awareness gap of chicken keepers on improved breed management. The mortality of chickens was low and it was the collective effect of different causes such as disease, stress due to long journeys, predators, and mechanical damage. A similar mortality value was reported by Bangu [8], the average mortality of the

"Bovan Brown" chicken breed in the Wondogenet district, Ethiopia was 1.74% and Solomon et al [9], the average survival of "Bovan Brown" chicken breed for Eastern Amhara region, Ethiopia was around 94%. Similarly, Elias [10] also reported that the mortality due to disease was lower, due to the effective use of the vaccination schedule as recommended by the National Veterinary Institute for Chicken.

Table 1. Survival and Mortality of Chickens

Code	Distributed	Survived	Mortality	Causes of mortality			
				Disease	Predator	Stress	Injury
HH1	21	20	1	-	-	1	-
HH 2	21	19	2	1	-	1	-
HH 3	21	19	2	1	1	-	-
HH 4	21	20	1	-	1	-	-
HH 5	21	20	1	-	1	-	-
HH 6	21	20	1	1	-	-	-
HH 7	21	18	3	1	1	1	-
HH 8	21	20	1	-	-	1	-
HH 9	21	20	1	1	-	-	-
HH10	21	20	1	-	1	-	-
HH11	21	20	1	1	-	-	-
HH12	21	20	1	1	-	-	-
HH13	21	21	-	-	-	-	-
HH14	21	20	1	1	-	-	-
HH15	21	21	-	-	-	-	-
HH16	21	18	3	1	1	1	-
HH17	21	19	2	-	-	1	1
HH18	21	20	1	1	-	-	-
HH19	21	20	1	-	1	-	-
HH20	21	19	2	1	1	-	-
HH21	21	21	-	-	-	-	-
HH22	21	15	6	-	-	-	6
HH23	21	21	-	-	-	-	-
HH24	21	19	2	1	-	1	-
HH25	21	19	2	-	-	1	1
Total	**525**	**489**	**36**	**12**	**8**	**8**	**8**
%		**93.1**	**6.9**	**33.4**	**22.2**	**22.2**	**22.2**

HH = Household. Values in the table represent the numbers of chickens, respective mortality, and causes of mortality.

Body Weight

The average body weight of the "Bovan Brown" chicken breed at the age of 3rd, 5^{th,} and age at first egg laying was presented in (Table 2). The average body weight of the "Bovan Brown" layer breed was 1.5 Kg. Some higher body weight value was reported than the report of Bangu [8] and Habtamu et al [11], the average body weight of the "Bovan Brown" breed at the age of first egg laying was 1.3612 Kg and the average body weight of Lohman Brown chicken breed at 20 weeks was 1.1006 Kg respectively, attributed due to supplementation of locally formulated feeds that enhances the increment of the body weight of chickens.

Age at first egg Laying

The average age at the first egg lay of the "Bovan Brown" breed was presented in (Table 2). The "Bovan Brown" layer breed reached the age of sexual maturity at 26 weeks. Late age of sexual maturity was reported than the report of Bangu [8] for the Wondogenet district, the average age of sexual maturity was 21.5 weeks, and might be due to the supplemental feed difference, i.e. the chickens in the former study used commercial feed, whereas, it was locally formulated feed in the current study. Similarly, the fast age of first egg laying was reported by Habtamu et al. [11], the age at first egg laying of the Lohmann Brown layer breed was 21 weeks, due to the cumulative effect of breed, agro-ecology, feed, and feeding.

Table 2. Body Weight and Age at First Egg Laying

Code	3rd month	5th month	Sexual maturity	Age at 1st egg laying
HH1	1.01 Kg	1.32 Kg	1.77 Kg	170 days
HH 2	0.98 Kg	1.10 Kg	1.32 Kg	180 days
HH 3	1.10 Kg	1.35 Kg	1.84 Kg	160 days
HH 4	1.05 Kg	1.25 Kg	1.59 Kg	175 days
HH 5	1.02 Kg	1.25 Kg	1.52 Kg	182 days
HH 6	1.15 Kg	1.37 Kg	1.63 Kg	165 days
HH 7	1.01 Kg	1.16 Kg	1.59 Kg	170 days
HH 8	1.20 Kg	1.57 Kg	1.82 Kg	170 days
HH 9	1.17 Kg	1.43 Kg	2.08 Kg	177 days
HH10	1.01 Kg	1.36 Kg	1.88 Kg	172 days
HH11	1.04 Kg	1.40 Kg	1.70 Kg	210 days
HH12	1.22 Kg	1.52 Kg	1.71 Kg	185 days
HH13	1.01 Kg	1.32 Kg	1.52 Kg	185 days
HH14	1.02 Kg	1.24 Kg	1.48 Kg	180 days
HH15	1.00 Kg	1.17 Kg	1.55 Kg	175 days
HH16	1.07 Kg	1.24 Kg	1.55 Kg	180 days
HH17	0.98 Kg	1.09 Kg	1.14 Kg	210 days
HH18	1.04 Kg	1.13 Kg	1.73 Kg	170 days
HH19	1.26 Kg	1.48 Kg	1.60 Kg	196 days
HH20	1.08 Kg	1.34 Kg	1.47 Kg	180 days
HH21	1.24 Kg	1.53 Kg	1.79 Kg	185 days
HH22	1.15 Kg	1.37 Kg	1.56 Kg	210 days
HH23	0.95 Kg	1.10 Kg	1.20 Kg	210 days
HH24	1.15 Kg	1.35 Kg	1.58 Kg	190 days
HH25	0.98 Kg	1.13 Kg	1.21 Kg	190 days
Average	**1.08 Kg**	**1.30 Kg**	**1.59 Kg**	**183 days**

HH = Household. G = Gram. Kg = Kilogram. Values in the table represent body weight and age at the first egg laying.

Egg Production Potential of the Breed

The average number of chickens/households, number of eggs/chicken/years, and total number of eggs/household/years are presented in (Table 3). The "Bovan Brown" chicken breed produced 237 medium to large-sized eggs per hen per year. Similarly, the average egg production of the "Bovan Brown" layer breed was 266.32 eggs per year per hen [12]. However, a higher average number of eggs/hen/years was reported than the report of Amanuel and Abdissa [13], the average number of eggs per hen per year of the Bovan Brown commercial breed was 189 eggs.

The average egg weight of the "Bovan Brown" chicken breed at different egg-laying periods is presented in (Table 3). The egg weight of the "Bovan Brown" layer breed at 5%, 10%, 50%, and 95% laying period was 48, 51, 53, and 57 g, respectively, with an overall egg weight of 52.25 grams. The weight of the egg was increasing from one laying period to another, and the lowest egg weight was recorded in the 5% egg-laying period whereas the highest was in the 95% egg-laying period. In line with Bangu [8]; the average egg weight of the same breed was 55.688 g for the Wondogenet district, and Habtamu et al. [11]; the average on-farm egg weight of the Lohman Brown layer breed was 54.2 g for Benishangul Gumuz region, Ethiopia.

Table 3. Egg production and weight

Code	№ of hens	№ of eggs /hen/year	№s of egg/hh	Egg weight at different periods (%)				
				5	10	50	95	Average
HH1	18	227	4086	57	58	60	65	60.00
HH 2	18	228	4104	47	48	47	54	49.00
HH 3	18	243	4374	51	51	55	65	55.50
HH 4	19	229	4351	45	51	50	55	50.25
HH 5	18	240	4320	46	51	51	54	50.50
HH 6	19	228	4332	50	51	53	53	51.75
HH 7	17	262	4454	50	52	60	72	58.50
HH 8	19	236	4484	48	51	50	51	50.00
HH 9	18	222	3996	50	52	53	54	52.25
HH10	19	239	4541	50	52	54	60	54.00
HH11	19	229	4351	50	50	52	53	51.25
HH12	18	241	4338	48	51	52	55	51.50
HH13	20	235	4700	48	51	54	57	52.50
HH14	19	241	4579	44	53	55	58	52.50
HH15	20	253	5060	46	48	50	52	49.00
HH16	17	241	4097	49	50	54	55	52.00
HH17	18	228	4104	47	51	54	60	53.00
HH18	19	233	4427	45	50	53	56	51.00
HH19	19	242	4598	49	51	52	53	51.25
HH20	18	243	4374	45	51	52	52	50.00
HH21	20	240	4800	47	51	56	65	54.75
HH22	15	237	3555	53	54	56	58	55.25
HH23	20	240	4800	50	52	53	53	52.00
HH24	18	229	4122	47	50	53	55	51.25
HH25	18	241	4338	48	52	55	56	52.75
Average	**18.44**	**237.06**	**4371.4**	**48**	**51**	**53**	**57**	**52.25**

HH = Household. Values in the table represent the number of chickens/households, number of eggs/ chicken/years, total number of eggs/household/years, and average egg weight of hens.

Chicken keeper's Perception and preference

The “Bovan Brown” layer breed was prepared due to its egg production, large egg weight, fast age of sexual maturity, feather color, ability to convert the supplemental feed to egg, and ease of manageability. However, some of the chicken keepers were worried about the feed shortage, absence of commercial feed, breed sources, and chicken veterinary drugs/vaccines problems.

Partial budget analysis

The partial budget analysis of the “Bovan Brown” layer breed is presented in (Table 4). It was based on changes in the Total Return (ΔTR), and Total Variable cost (ΔTVC). The change in Total Variable Cost (ΔTVC) included chicken purchase, feed purchase, and medication cost whereas, the change in Total Return (ΔTR) included income from the sale of eggs, sale of unproductive hens, and sale of laying hens. Finally, the change in net income (ΔNI) was the change in total return (ΔTR) and the change in total variable costs (ΔTVC).

$\Delta NI = \Delta TR - \Delta TVC$

$\Delta NI = 423232 - 208775$

$= 214457$ for 25 members

$\Delta NI = 8578.28$ Ethiopian birr for each.

There was a difference in the change in total return (ΔTR) and income among members of households due to the variability of change in total variable costs and, finally each member of the household got an income of 8578.28 Ethiopian birr on average.

Challenges and opportunities

The shortage of chicken feed, drought, absence of infrastructures, lack of access to veterinary drugs and vaccines, and market problems were some of the challenges but, newly emerging agricultural farming system and irrigation opportunities, human power and merchants flow from the central area were some

of the opportunities that give hope to expand the chicken production.

Table 4. Partial budget analysis

	Cost				Income				
Code	Chick cost	Feed cost	Medication cost	TVC	Egg sale	Spent hen sale	Hen sale	TR	Profit
HH1	3150	5500	400	9050	10300	1000	3600	14900	5850
HH 2	3150	5000	400	8550	11260	500	3600	15360	6810
HH 3	3150	5100	300	8550	12873	500	3600	16973	8423
HH 4	3150	4500	300	7950	11743	500	3800	16043	8093
HH 5	3150	4900	200	8250	12229	1200	3600	17029	8779
HH 6	3150	4700	450	8300	12439	600	4750	17789	9489
HH 7	3150	4800	250	8200	12632	600	3400	16632	8432
HH 8	3150	5200	300	8650	13129	500	3800	17429	8779
HH 9	3150	5000	300	8450	11893	1400	3600	16893	8443
HH10	3150	5400	300	8850	13230	500	3800	17530	8680
HH11	3150	4700	400	8250	12898	500	3800	17198	8948
HH12	3150	4300	250	7475	12765	1300	3600	17665	10190
HH13	3150	5500	400	9050	12730	550	4000	17280	8230
HH14	3150	5350	350	8850	13699	450	3800	17949	9099
HH15	3150	4680	450	8280	14844	500	4000	19344	11064
HH16	3150	4500	300	7950	11267	600	3400	15267	7317
HH17	3150	4950	400	8500	11638	500	3600	15738	7238
HH18	3150	5000	350	8500	12891	600	3800	17291	8791
HH19	3150	4800	250	8200	13640	450	3800	17890	9690
HH20	3150	4550	400	8100	13223	500	3600	17323	9223
HH21	3150	5500	300	8950	14473	550	4000	19023	10073
HH22	3150	3000	250	6400	10301	0	3000	13301	6901
HH23	3150	4500	350	8000	13874	550	4000	18424	10424
HH24	3150	5300	400	8850	12359	600	3600	16559	7709
HH25	3150	4970	500	8620	12352	450	3600	16402	7782
Total				**208775**				**423232**	**214457**
Average (profit)				**8351**				**16929**	**8578**

TVC = total variable cost; TR = total return; NI = Net Income; Δ = change; values (numbers) in the table represent the amounts of the respective variable.

Conclusion

The “Bovan Brown” layer breed adapted, performed well, and was preferred by chicken keepers due to its survival, egg production, disease resistance, and fast age of sexual maturity. The higher body weight value and late age of sexual maturity were recorded. Although the breed adapted and performed well, there were some limitations such as feed shortage, limited access to commercial feed, absence of initial breed, veterinary drugs/vaccines, and awareness gap of chicken keepers. Therefore, the chicken keepers should be trained about the layer’s feed ingredients, especially, protein sources, and the distribution of the breed should be limited to urban, peri-urban, model, and trained keepers with access to infrastructure such as roads to get inputs and sale outputs.

Lists of Abbreviations

P.O, Post Office; Kg, Kilogram; g, gram; sq., square kilometer; Km, Kilometer; mm, mill meter; ^{o}c, degree Celsius; SPSS, Statistical Package for Social Science; HH, House Holds; Δ, change; TR, Total Return; TVC, Total Variable Cost; NI, Net Income; CSA, Central Statistical Authority; FAO, Food and Agricultural Organization; and SOZFEDD, South Omo Zone Finance and Economic Development Department.

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Conflicts of interest

The authors declare that there is no conflict of interest and the paper has not been submitted for publication to another journal.

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Authors’ contribution

Mr. Elias Gonta wrote the entire manuscript in addition to conducting the research work and data collection. Mr. Mekete Girma was involved in proposal development and manuscript editions.