



## RESEARCH ARTICLE

# Participatory evaluation and demonstration of productive performance of *Bovans Brown* chicken under village production system in Menit Shasha Woreda, West Omo Zone, Ethiopia

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## Abstract

The study was conducted in Charuhurit kebele in Menit Shasha woreda West Omo Zone, south west region (SWR) Ethiopia. Before the commencement of the study need assessment was done on existing livestock production system and their constraints through conducting group discussion with pastoralists, then the pastoralists were prioritized poultry production system as major problem need immediate intervention. A pastoralist and agro-pastoralist extension research group (PAPREG) which containing 25 pastoralists were established and randomly assigned to different production system (10 intensive productions, 10 semi intensive and five extensive production system). 125 pullets of Bovan Brown chicken breed age 75 days purchased from Bushoftu Alema farm were distributed and before distribution training on housing, feeding, health and overall handling system of animals were given for pastoralists. The study revealed that high mortality rate or low survivability rate was observed before the onset egg production in the study area. There were no significant differences in age of animals before onset of egg lying, but number of egg produced every month was significantly ( $p < 0.05$ ) higher between production systems. The average age at onset of egg lying was 22.10 weeks. The result shown that significantly ( $p < 0.05$ ) higher number (23.77) of eggs per month per hen was recorded for intensive production system. Finally, the authors concluded that Bovan Brown chicken breed under village production in terms of their egg production performance were feasible in the study area to enhance family nutrition and income generations.

**Key words:** Chicken, Egg, Income, Mortality, Need assessment, Pastoralists, Production system.

## Introduction

Ethiopia is one of the African countries which have pastoralist, agro pastoralist and agronomists in the rural areas (85% of the total population). Most of the livelihoods' of rural community survive through agriculture practices. Chicken are widespread and almost every rural family owns chickens, which provide a valuable source of both family

protein and income (Tadelle *et al.*, 2003). The total chicken population in the country is estimated to be 57 million with native chicken type representing 78.85%, hybrid chicken 12.02% and exotic breed 9.11 (CSA, 2021). The most dominant chicken types reared in Ethiopia are local ecotype, which show a large variation in body position, plumage color, comb type and productivity (Halima, 2007). However, the economic contribution of the sector is not still proportional to the huge chicken numbers, attributed to the presence of many productions, reproduction and infrastructure constraints (Halima, 2007; Fikadu, 2021).

The chicken production system in Ethiopia can be characterized by not market oriented, low input, scavenging and traditional management system consisting of local breed (Afras, 2018). The indigenous birds are small in body size and low producers of meat and egg. The egg production potential of local chicken is 30 to 60 eggs/year/hen with an average of 38 g egg weight under village management conditions, while exotic breeds produce around 250 eggs/year/hen with around 60 g egg weight in Ethiopia (Yizengaw *et al.*, 2022). The total chicken egg and meat production in Ethiopia is estimated to be about 78,000 and 72,300 metric tons, respectively (Buli, 2017).

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The previous regional state Southern Nation and Nationality People (SNNP) is habitat of about 18.8% the total national chicken population and contributes about 18% of the total annual national egg and chicken meat production. The regional rural areas comprises of about 97.9% of the total regional chicken population while the urban areas constitute 2.1%. There are no large commercial chicken units, but the Regional State Bureaus of Agriculture (RSBA) operates 4 chicken breeding and multiplication centers namely Awassa, Walayita Sodo, Gubre and Bonga (Yilma, 2008). However, there is no available information regarding chicken population and their contribution in national egg and meat supply in newly established Southwester regional state.

In Southwestern region poultry husbandry is mainly traditional type and poor production which characterized by low input and affected with various constraints. Chicken are houses/coops and temporary shelters are used to protect the birds during the night from adverse weather and predators or to provide laying shelter. Supply of feed is limited to kitchen waste and when available small amounts of grain are provided. The birds largely subsist on scavenging in gardens, village alleys and surroundings of the farms by feeding on crop residues, insects, worms and green forage. Menit Shasha woreda is one of pastoralist district which is generally characterized by the lowest development indicators, highest incidence of deep rooted problems and food insecurity. The woreda community economic and livelihoods are mainly depending on livestock production. This research project was initiated and prioritized from raised problems by the community in the selected area. As in the other part of the country (Ethiopia) the traditional chicken production system is common in woreda. They are characterized by small flock size, low input and output and periodic devastation of the flock by disease. There is no separate chicken house and the chickens live in family dwellings together with human population. There is no purposeful feeding of chickens and scavenging is almost the only source of diet. There is no designed selection and controlled breeding. Because of the previous government have minimum attention to pastoral areas, mainly due to their remoteness, lack understanding of their livelihoods and traditional knowledge, lack access of service and largely disconnected from the main economy of the country; interims of trade, undeveloped or lack of transport and communication infrastructures.

High incidence of chicken diseases, mainly (NCD) is the major and economically important constraints for village chicken production systems followed by feeds, lack of proper housing system. Among the infectious diseases, salmonellosis, Gumboro, coccidiosis and fowl pox are also considered to be the most important causes of mortality in local chicken while predators are additional causes of losses (Eshetu *et al.*, 2001; Halima, 2007). Village poultry production is constrained by poor access to markets, goods and services, weak institutions and lack of skills,

knowledge and appropriate technologies. Therefore, this study was designed to evaluate and demonstrate the production performance and adaptability of Bovan Brown chicken breed in Menit Shasha district to enhance the family nutrition and income of pastoralists.

## Materials and Methods

### 2.1 Site and Pastoralist Selection

The demonstration was conducted at Menit Shasha woreda. It is located at 072E and 36N<sup>08</sup> with an altitude of up to 1667m.a.s. Chiruhartu kebele of Menit Shasha woreda was selected purposively. The project was initiated through conducting need assessment at kebele levels. The PAREG team was held discussion with pastoralist then they prioritized the major constraints that hinder livestock productivity in the area. Together with pastoralists of kebele; thematic area was selected and prioritized for immediate intervention. Chicken production system was selected as first rank for intervention, because chicken are immediate protein sources and generate more income for household, but local chicken is low in egg production performance and high disease prevalence. A PAPREG team which containing 25 pastoralists were developed. The pastoralists were selected by considering gender, youth, willingness, educational background and community consensus for this research project. Finally, the PREG team was decided to intervene on poultry production system.

### Research Design

The PAPREG was grouped in to three groups (Intensive (Group I), Semi-intensive (Group II) and Extensive (Group III)) having different member in each group were taken as treatment of study. The pastoralists included in these groups were taken as replication. The first and the second group had 10 members and the third group had five members. Each of the three groups was utilized different input (receive different treatment). The first group was used technology based input namely; house constructed from corrugated iron sheet and meshes wire for live birds, concentrated feed supplementation, routinely provision of health care, utilization of water and feed through. PAPREG in group two was used similar input with group one in utilizing all the material listed under group one but the material was totally manufactured from locally obtained material in the area and utilized by the pastorals in the group. The third group was considered as control which use the traditional production system commonly known under the pastoral and agro pastoral community in the research site without any consideration of input except the provision of training, distribution of chicken and some drug and vaccination (if there any disease occurrence).

### Training and Chicken Distribution

A total of one hundred and twenty-five (125) Bovan Brown pullets have been purchased from Alema Farm, Bushoftu

town, and distributed to pastoralists with commercial feed. Before the arrival of these pullets, training was given for PAPREGs members, DAs, and woreda experts on the overall poultry management system (feeding, watering, health care housing, data collection, and recording)(Figure1) , and then the pullets and feeding and watering troughs were distributed according to their respective groups. Continuous follow-up was done by the DA, researcher, and expert of Menit Shasha woreda throughout the production period.

### **Technology Demonstration and Evaluation Techniques**

Pastoralist and Agro-pastoralist research extension group (PAPREGs) members and other follower pastoralist were encouraged to participate on different extension/promotional events organized at each demonstration site. These are mechanisms used to enhance pastoralist-to-pastoralist learning and information exchange such as trainings, field visits/tours, experience sharing, field days, etc. At the end of intervention the monitoring and evaluation was conducted which include the comparison of improvement in each group and the result demonstrate to the whole PAPREGs and the surrounding community. Thus, mini field days was organized at demonstration site in order to involve key stakeholders and enhance better linkage among relevant actors. Discussion session and result communication forum was also organized.

### **Pastoralist Preferences and Selection Criteria**

The technologies was demonstrated, evaluated at production stage and validate by pastoralist, agricultural experts, development agents, researchers and other stakeholders based on the selection criteria. Pastoralists were carried out qualitative and quantitative evaluation on egg production, disease resistances, rapid sexual maturity and escaped of birds from predator of intervene technology as compared to traditional production existed in the area.

### **Profitability Analysis**

A profitability analysis was demonstrated to evaluate the profitability of Bovan Brown chicken production



Figure 1: Training the pastoralist before distribution of chicken

at village level following Intensive, semi-intensive and traditional production systems. The analysis was performed considering the main input costs such as chicken price, replacement rate of fixed resources (depreciation cost of house and farm equipment), feed price, medication cost and labor expenses. Assumptions made on fixed asset were 10% of total cost of construction for house and 20% of total cost of purchased for farm equipment as replacement rate in 10 and 5 years, respectively. The maintenance cost of house and farm equipment also were considered at rate of 5 percent of total cost of construction and purchasing per year. The labor expenses also assumed that a family head may spent 1 hour, 0.5 and 0.3 hour to manage chicken on Intensive, Semi-intensive and Traditional production systems respectively. These hours were converted to national working hours (8 hours/day) of employed daily laborer. The labor expenses were according to daily laborer salary payment of the country. The price of chicken and feed that purchased from known organization considered as it was and price homemade was taken from prices of grains in local market of study area. The selling cost of output such as eggs, and culled chicken (salvage value of chicken) was taken from existing market prices of the study area. The cost of manure used as fertilizer was calculated in comparison with the cost of inorganic fertilizer (Urea.) The total return (TR) was taken as difference between average selling price of farm output and purchase price of each chicken. The calculations for the following economic parameters were done according to Upton (1979) as follows:

$NR = TR - TVC$ ;  $MRR = \Delta NR / \Delta TVC$ ; Where NR = net return; TR = total return; TVC = total variable cost; MRR = marginal rate of return.

### **Data Collection and Analysis**

Both qualitative and quantitative data were collected using appropriate data collection methods such as focused group discussion (FGD), interview individual pastoralist and direct counting of live birds. The collected data were organized using descriptive statics such as percentage and rank, however quantitative data were analyses by using SAS software 9.1.3 (SAS, 2008). Where there is significant difference between means, the mean separation was made adjusted Tukey honestly significant difference test.

## **Results and Discussion**

### **Training and Field Day**

Both theoretical and practical training was given for 25 members (13 man and 12 women) PAPREGs and three DAs of Charuharit kebele on over all chicken management system like housing, feeding, watering, health care, data collection, and recording and product utilization before the introduction of the technology. At the final stage of study field day was arranged and a total of 50 pastoralists (25 Men



**Figure 2:** Field day demonstration of pastoralist community member with improved technology

and 25 women) pastoralists in kebele were participated and introduced about improved chicken production technology, product utilization as sources of protein of family members and income generation (Figure 2). The perceptions of all pastoralists of PAPREG members, DAs, woreda expert and other neighboring pastoralists were aware regarding about skill and knowledge improved chicken production technology through utilization of improved breed and improved management system and they accept as a better strategy to improve the livelihood of pastoralist community in ensuring family members with high quality protein nutrition and income generation.

#### **Mortality and survivability of chicken**

Mortality and survivability rate of Bovan Brown chicken in study area is presented in Table 1. The highest mortality rate (36%) chicken was recorded before the onset of egg production for Bovan Brown chicken reared under traditional and semi-intensive production system. The reasons for the death of birds were diseases and predators. Overall highest mortality rate (33.6%) of Bovan Brown chicken was recorded at study area before onset of egg production. The findings of the current study was higher than the results (8.51%) and (1.74%) reported by Gezahegn *et al.* (2016) and Bekele (2018) respectively, but lower than the values (54.85%) reported by Samson *et al.* (2013) on Fayoumi breed. On the other hand, the survivability of Bovan Brown chicken breed was low (66.4%) starting from pullet until onset of egg production

**Table 1:** Status of Bovan Brown chicken distributed before onset of egg production

<i>Production system</i>	<i>Chicken disseminated</i>	<i>MR %</i>
Traditional	25	36
Intensive	50	30
Semi intensive	50	36
Over all	125	33.6

TCHD= Total chicken distributed; MR%= Mortality rate

**Table 2:** Perceptions of pastoralist toward technology

<i>Pastoralist perception of birds</i>		
<i>Characters</i>	<i>No of farmer</i>	<i>Response %</i>
Egg production	25	100
Disease resistant	25	100
Ability to rear year round	25	100
Rapid sexual Maturity	25	100

in study area. This indicates that survivability of Bovan Brown chicken in the study area highly constrained by poor managements (feeding and watering), diseases, predators and low adaptability of young chicken to cold environment, because the chicken were disseminated for the pastoralists during early summer (July 1<sup>st</sup>) and no chicken mortality was recorded for long dry period season. In line to the current study Birahanu Kassa (2021) reported that young chicken less adapted to cold season as compared to dry season. However, Solomon *et al.* (2017) was reported higher survivability (94%) rate for Bovan Brown chicken breed chicken around Dessie town in Amhara National Regional State.

#### **Perception of Pastoralists**

The perception of pastoralists was tested during the production stage of Bovan chicken (Table 2). They were satisfied by the breed and decided to improve poultry production with improved managements, because the breed has paramount advantages than the breeds they know before. Some of the advantages mentioned by pastoralists were better egg production, ability to disease resistances, ability to year round production and rapid sexual maturity.

#### **Age and egg production**

Age at onset of egg laying and egg production for seven consecutive months of Bovan Brown chicken breed reared under different management system in Chiruhurut village are presented in Table 3. The study revealed that the average age at onset egg production was 22.10 weeks. There was no significant difference in age at first lay among Bovan Brown chicken kept under different production system. In line to current findings similar age (22 weeks) at onset egg was reported by Bekele (2018) on the same breed. However, lower than the value reported by Gezahegn *et al.* (2016) an average age at onset of egg production for Koekoek

**Table 3:** Age at first egg laying and egg production thorough productive months

Variables	Intensive	Semi-intensive	Extensive	SEM	p-value
AFL in week	21.50	21.90	22.90	0.43	0.09
Month 1	42.00 <sup>a</sup>	31.10 <sup>a</sup>	17.20 <sup>b</sup>	3.5	0.001
Month 2	83.60 <sup>a</sup>	46.80 <sup>b</sup>	32.40 <sup>b</sup>	6.9	0.001
Month 3	86.20 <sup>a</sup>	61.60 <sup>ab</sup>	49.00 <sup>b</sup>	8.5	0.02
Month 4	91.80 <sup>a</sup>	70.80 <sup>ab</sup>	58.00 <sup>b</sup>	7.8	0.02
Month 5	93.40	77.20	65.40	8.5	0.09
Month 6	95.00	82.00	70.43	8.9	0.17
Month 7	97.00	86.00	73.60	9.0	0.21
Laying %	79.24 <sup>a</sup>	68.10 <sup>b</sup>	64.43	0.67	<0.001
AMPH	23.77 <sup>a</sup>	20.43 <sup>ab</sup>	19.60 <sup>b</sup>	0.3	<0.001
AYPH	285.26 <sup>a</sup>	245.13 <sup>b</sup>	231.94 <sup>c</sup>	2.41	<0.001

<sup>a,b</sup>Means of each parameter with different superscripts within the same column are significantly different at  $p < 0.05$ ; SEM= Standard Error Mean; AFL: Age at first laying; AMPH: Average monthly egg production per hen; AYPH: Average yearly egg production per hen

and Bovan Brown as 27.4 weeks. The average number of eggs produced by household per month was significantly affected between months for different production system. The study revealed that significantly ( $p < 0.05$ ) higher average number of egg produced per month per hen was recorded for intensive production system and followed by semi-intensive and extensive production system. The value of 23.77 eggs per month per hen obtained from intensive production is higher than the average value of 20.8 egg per month per hen reported by Aderaw *et al.* (2021) for the same breed for the first six productive months, but the results recorded for other production system are similar with this value. However, similar value of  $266.32 \pm 8.7$  eggs and  $292.4 \pm 17.9$  eggs reported by Desalew *et al.* (2013) and Tomas *et al.* (2017) annual production for the same breed

### Constraints of Chicken Production

The current study revealed that feed shortage, diseases and predators were most economical challenges in the study area (Table 4). This results consistent with the findings of Salo *et al.* (2016) who reported that feed shortage, diseases, predators and poor housing conditions were constraints of chicken production in Lemo District, Hadiya Zone. Likewise, Fisseha *et al.* (2010) reported that diseases were the major economically challenge in village poultry production system. Halima (2007) also reported that in northwest part of Ethiopia predation is one of the major economically challenge of poultry production. Even though, the relative survivability of chicken was low due to high prevalence of predators (fox and wild dog) and diseases, the pastoralists were pleased by breed because of high production performances and decided to improve poultry production system with appropriate technology.

**Table 4:** Constraints of chicken production

Sr No.	Constraints	No of resp.	Percentage	Rank
1	Feed shortage	12	48	1 <sup>st</sup>
2	Disease	2	8	3 <sup>rd</sup>
3	Predators	9	36	2 <sup>nd</sup>
4	Lack of improved breed	2	8	3 <sup>rd</sup>

**Table 5:** Profitability analysis of *Bovan Brown* Chicken at village level under different production systems

Variables	Production system		
	Traditional	semi-Intensive	Intensive
Total number of layer evaluated per house hold	5	5	5
Purchase price of chicken (ETB)	850.00	850.00	850.00
Total feed intake (Kg)/year	-	109.50	219.00
Feed cost (ETB)/year	-	2737.50	8760.00
Transportation and loading/unloading cost of feed	-	-	819.00
Depreciation cost of house/year	-	50.00	100.00
Depreciation cost of farm equipment/year	-	-	430.00
Maintenance cost of chicken house	-	-	50.00
Treatment cost/year	20.00	30.00	40.00
Labor cost per farm per year (ETB)	1368.75	2281.25	4562.50
Total variable cost (ETB)	2238.75	5098.75	15611.5
Annual egg produced	1176.00	1225.80	1426.20
Annual manure collected (30% of F. consumed) in kg	-	33.00	70.00
Selling price of eggs (ETB)	11760.00	14710.2	17114.4
Salvage value (Price of culled bird)(ETB)	1500.00	1500.00	1500.00
Estimated cost of chicken manure used as fertilizer	-	357.00	657.00
Total return(TR) (ETB)	15612.00	16567.20	19271.40
Net return(NR) (ETB)	13373.25	11468.45	3659.90
Change in net return ( $\Delta$ NR)	-	-1.90	-9.70
Change in total variable cost ( $\Delta$ TVC)	-	2860.00	13372.75
Marginal rate of return(MRR)	-	-0.00067	-0.0007

### Profitability Analysis of Each Production System

The current study revealed the highest economic gain was obtained from traditional production system because of utilization of low production cost, whereas the economic losses was recorded for intensive and semi-intensive production system due to utilization of high input cost (Table 5). This study indicates that any production system

that inquires any additional cost except supplementing homemade waste and medications could not be practical applicable on small flock at household levels. However, intensive production system will be practically become visible when the flock size increased and laying capacity exceeded 80 percent according to current marketing prices of farm products and input cost.

### Conclusion and Recommendation

The higher egg production performance of Bovans brown chicken breed obtained under this study from all production systems had increased the pastoralists' acceptance of poultry production improvement technology. Feed shortage, diseases, predators and lack of improved breeds are major economically important challenges in the study area. Among production systems tested by current study, the existing traditional production system was more economically when we consider the cost of all input, including labor, farm equipment and construction. Even though the technology has got highly accepted among pastoralist groups due to high disease resistance, rapid sexual maturity and year-round egg production, high loss of birds before the onset of egg production needs greater attention by pastoralists and experts. Therefore, appropriate veterinary services, training on poultry production and management, and organization of poultry feed suppliers are necessary to overcome the constraints in the study area.

### Challenges

The study area was constrained with different infrastructures like road facilities, electric city and telephone services. For the researcher, continuous follow-up of the study and communication with site development agent (DA) was difficult. The expectation intensives and all facilities required by pastoralists from the project were also the study challenges. There was also a communication gap among PAPREG members.

### Lessons Learnt

The participatory approach demonstration of chicken production involved pastoralists in problem identification, priority setting, planning and implementation of the study were equipped the pastoralist with knowledge and skill of chicken production. The development of spirit working with pastoralists, the exchange of ideas, experiences and knowledge among and between groups equipped us with knowledge and skill of village chicken production. Generally, the study was improved researcher-extension worker-pastoralist linkage to tackle any problems at grass root level.

### Author Contributions

RB contributed in designing study, conducting study, statistical data analysis, and manuscript writing. WM contributed in designing study, supervising study, statistical

data analysis, and manuscript writing. WW contributed in designing study, conducting study, statistical data analysis and manuscript writing. YT contributed in designing study, supervising study, and manuscript writing. TB, BT and HN contributed in designing study, supervising study, and manuscript review.

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### References

- Aderaw, L., Fisseha, M., & Damitie, K. (2021). Growth, survival and egg production of exotic chicken breeds under small scale production system in Bahir Dar City Administration, Amhara Region, Ethiopia. *Ethiopia. J. Sci. Technol.* 14(2): 123-137
- Afras, A. (2018). Review on Chicken production in Ethiopia with emphasis on Meat Production, Munich, GRIN Verlag. <https://www.gri.com/document/38849>
- Bekele, B. (2018). Demonstration and Evaluation of Small-Scale Family Poultry (Bovans Brown Layers) at Wondogenet Woreda, Sidama Zone, SNNPR, Ethiopia. *J Fisheries Livest Prod* 6: 284. doi: 10.4172/2332-2608.1000284
- Birhan, K., Wondmeneh, E., Yosef, T. & Tadelle, D. (2021). On-farm comparative evaluation of production performance of tropically adapted exotic chicken breeds in western Amhara, Ethiopia. *Journal of Applied Poultry Research*, doi: <https://doi.org/10.1016/j.japr.2021.1000194>.
- Buli, T. (2017). The Production Performance of the Ethiopian Indigenous Chickens, Munich, GRIN Verlag, <https://www.grin.com/document/384386>
- CSA (Central Statistic Authority). (2021). Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey 2020/21. Report on Livestock and Livestock Characteristics (Private Peasant Holdings), Addis Ababa, Ethiopia.
- Desalew, T., Harpal, S., Ashenafi, M., Wondimeneh, E., & Tadelle, D. (2013). Study on productive performances and egg quality traits of exotic chickens under village production system in East Shewa, Ethiopia. *African Journal of Agricultural Research* 8(13): 1123-1128.
- Eshetu, Y., Mulualem, E., Ibrahim, H., Berhanu, A., & Aberra, K. (2001). Study of gastro-intestinal helminthes of scavenging chickens in four rural districts of Amhara region, Ethiopia. *Rev. Sci. tech off. Int. Epiz*, 20(3): 791-796.
- Fikadu, W. (2021). Review on poultry production status and economic contribution of the sector in Ethiopia. *Food Sciences and Quality management* 109: 1-9

- Fisseha, M., Azage, T., & Tadle D. (2010). Indigenous Chicken production and marketing system in Ethiopia: Characteristics and opportunities for market oriented development. Improving Productivity and Market Success of Ethiopia Farmers, Ethiopia.
- Gezahegn, T., Ashenafi, M., & Berhun, T. (2016). Evaluation of the egg production performances in Bovan Brown and Koekoek chicken Breeds under Varied Seasons and Feeding Regimes in south wollo Zone Ethiopia. *Global Veterinaria* 17: 318-324
- Halima, H. (2007). Phenotypic and genetic characterization of indigenous chicken population in northwest Ethiopia. Faculty of Natural and Agricultural Sciences Department of Animal Wildlife and Grassland Sciences University of the Free State Bioemfonte in South Africa.
- Mekonnen, G. (2007). Characterization of smallholder poultry production and marketing system of dale, Wonsho and Loka Abaya Weredas of southern Ethiopia. M.Sc. Thesis, Awassa College of Agriculture, Hawassa University, pp: 95.
- Salo, S., Tadesse, G., & Hilemeskel, D. (2016). Village Chicken Production System and Constraints In Lemo District Hadiya Zone Ethiopia. *Polt.WildiSci* 4:158
- Samson, L., Endalew, B., & Tesfa, G. (2013). Production Performance of Fayoumi Chicken Breed Under Backyard Management Condition in Mid Rift Valley of Ethiopia. *Herald Journal of Agriculture and Food Science Research Vol. 2 (1)*, pp. 078 - 081 January, 2013 Available online <http://www.heraldjournals.org/hjafsr/archive.htm>
- Solomon, T., Asress, Z., Niguse, B., Almayehu, A., & Dawud I. (2017). Demonstration of Commercial Layer Chicken "Bovans Brown" Technology Packages for Smallholder Poultry Producers in Eastern Amhara Ethiopia.
- Tadelle, D., Alemu, Y., & Peters, K. (2003). Village chicken production systems in Ethiopia: Use patterns and performance valuation and chicken products and socio-economic functions of chicken. *Livestock Research for Rural Development* (Available from <http://www.lrrd.org/lrrd15/1/tadeb151.htm>).
- Tomas, M., Niraj, K., Berihu, G., Etsay, K., & Tsegay, T. (2017). Performance of Bovans Brown chickens under intensive and backyard management system in Mekelle, Ethiopia. *Ethiopian Journal of Veterinary Science and Animal Production* 1(1): 73-80.
- Yizengaw, M., Ewonetu, K., & Ashenafi, G. (2022). Review of chicken productive and reproductive performance and its challenges in Ethiopia, *All Life*, 15:1, 118-125, DOI: 10.1080/26895293.2021.2024894