Research Article

Trend Analysis of Poultry Population Growth and Distribution in Ethiopia

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Abstract

The poultry population of Ethiopia is almost entirely composed of indigenous chicken, and recent estimates showed that 78.85%, 12.02%, and 9.11% are indigenous, hybrids, and exotic poultry, respectively. Poultry plays important roles in terms of generating employment opportunities, improving family nutrition, and empowering women. The growth of the poultry population over the year has almost stagnated because of high poultry mortality and the limited expansion of commercial poultry production. Therefore, this trend was initiated to analyze the trends of poultry population growth and distribution in Ethiopia. Data on annual poultry population growth and distribution in Ethiopia for the period of 2008 to 2021 were collected from the Central Statistical Agency (CSA). A trend test was carried out using the non-parametric Mann-Kendall's trend test packaged in XLstat. The outcome of this trend indicated that the poultry population increased significantly in some regions. However, the distribution of poultry populations across the region is not uniform. The Oromia region has the most poultry, followed by Amhara, the South Nation and Nationality People of Ethiopia (SNNP), and Tigray. This is due to the availability of commercial poultry farms. Therefore, the future study should pay attention to the expansion of large-scale commercial poultry farms across the regions and the introduction of exotic poultry breeds.

Keywords: Ethiopia, Poultry Population, Trend

Introduction

Ethiopia is naturally endowed with different agro-ecological zones, suitable environmental conditions, and is home to many livestock species. It is also suitable for livestock production. An estimate indicates that the country is home to about 57.01 million poultry (CSA, 2021). By these numbers, poultry is ranked second next to cattle. The Ethiopian poultry population is almost entirely composed of indigenous chickens. Poultry includes cocks, cockerels, pullets, laying hens, non-laying hens, and chicks. Recent estimates showed that 78.85%,

12.02%, and 9.11% are indigenous, hybrids, and exotic poultry, respectively (CSA, 2021).

Poultry production is one of the key livestock subsectors in Ethiopia. It plays important roles in terms of generating employment opportunities, improving family nutrition, and empowering women. It is a suitable business for poor households due to the small quantity of land needed and the low investment costs required to start up and run the operation (FAO, 2019). Also, their production has important economic, social, and cultural benefits and plays a significant role in family nutrition in developing countries. The proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, with the major increase being in the developing world (FAO, 2010).Ethiopia has about 60% of the total chicken population of East Africa, which includes local, exotic, and hybrid chicken breeds (Fuals *et al*., 2018). The largest proportion of poultry consists of laying hens (34.26%), followed by chicks (32.86%). Pullets account for an estimated 11.36% of the country's population. Cocks and cockerels are estimated at 11.2% and 5.74%, respectively. The rest are non-laying hens, which represent about 4.59% of the country's total poultry population (CSA, 2021).

Despite a high poultry population and favorable environmental conditions, the country's current poultry output is low. This is associated with a number of complex and interrelated factors, such as inadequate feed and nutrition, widespread diseases, poor genetic potential of local breeds, market problems, inefficiency of poultry development sectors, marketing, and infrastructure. Several studies indicate that poultry production is higher in areas nearer to the major poultry market centers and near the capital city (urban and pre-urban areas). However, no convincing study has been made so far to analyze the degree to which these factors hamper the production and distribution of poultry.The poultry population growth over the year has almost stagnated because of high poultry mortality due to a lack of adaptation of introduced exotic poultry, diseases, climate change, predators prevalent in

the scavenging production systems, and the limited expansion of commercial poultry production both in terms of the number of operators and volume of operations. Poultry farming offers considerable economic, social, and cultural benefits in developing nations, and it plays an important role in family nutrition. The average number of birds kept by rural households is five or six (Bushra, 2012). In addition, the Ministry of Agriculture established several exotic chicken breeding and multiplication centers throughout the country to strengthen national poultry extension efforts.

Due to the very important role the poultry sector plays in the economy of the country, the formulation of a feasible and geographically targeted development plan for the sector is indispensable. However, well-documented and recent information that can help devise this kind of development plan in Ethiopia is lacking. This trend attempts to fill this gap. This trend uses the non-parametric Mann-Kendall's trend test to determine the poultry population growth trend and spatial distribution based on the data reported by the Central Statistics Authority (CSA).

Source of data

Information on the number of Ethiopian poultry populations and distribution by region was obtained from the CSA (http://www.csa.gov.et/) annual report series, the agricultural sample survey (CSA 2008, CSA 2009, CSA 2010, CSA 2011, CSA 2012, CSA 2013, CSA 2014, CSA 2015, CSA 2016, CSA 2017, CSA 2018, CSA 2019, CSA 2020, CSA 2021). The annual Livestock Sample Survey covered the rural agricultural population in all the regions of the country except the non-sedentary population of Addis Ababa.

Methodology

Data on annual poultry population growth and distribution in Ethiopia for the period of 2008 to 2021 were collected from the Central Statistical Agency (CSA). Trend tests were carried out using

the non-parametric Mann-Kendall's trend test, which is less sensitive to outliers and tests for a trend in a time series without specifying whether the trend is linear or non-linear (Partal and Kahya, 2006; Yenigun *et al.,* 2008; Hadgu *et al.,* 2013). The Mann-Kendall's test statistic is given as:

$$S = \sum_{i=1}^{N-1} * \sum_{j=i+1}^{N} sgn\left(x_j - x_i\right) \quad equation \ (5)$$

where S is Mann-Kendall's test statistics; x_i and x_j are the sequential data values of the time series in the years *i* and *j* (*j >i*); and *N* is the length of the time series. A positive *S* value indicates an increasing trend, and a negative value indicates a decreasing trend in the data series. The sign function is given as

$$sgn(x_{j-}x_x) = \begin{cases} +1 \ if & (x_{j-}x_i) > 0 \\ 0 \ if & (x_j - x_i) = 0 \\ -1 \ if & (x_{j-}x_i) < 1 \end{cases} \quad equation \ (6)$$

The variance of *S* for the situation where there may be ties (i.e., equal values) in the *x* values is:

$$var(S) = \frac{1}{18}[N(N-1)(2n+5) - \sum_{i=1}^{m} t_i(t_i-1)(2t_i+5)] \quad equation \ (7)$$

Where *m* is the number of tied groups in the data set and t_i is the number of data points in the ith tied group. For n larger than 10, Z_{MK} approximates the standard normal distribution (Partal and Kahya, 2006; Yenigun*et al*., 2008) and is computed as follows:

$$\begin{cases} \frac{S-1}{\sqrt{var(S)}} & if \ S > 0 \\ 0 & if \ S = 0 \\ \frac{S+1}{\sqrt{var(S)}} & if \ S < 0 \end{cases} \quad equation \ (8)$$

The presence of a significant trend is evaluated using the Z_{MK} value. The null hypothesis Ho should be accepted in a two-sided trend test if Z MK $Z1-_\alpha/2$ at a given level of significance.The critical value of ZMK in the standard normal table is $Z1-_\alpha/2$.

Result and Discussion

The trend shows that Ethiopia's poultry population is growing, and the number of poultry has increased significantly over time. The trend analysis using regional dummies showed significant poultry population increases for all regions. Sen's slope value in tables 1 to 2 indicated that in Oromia, the poultry population (in millions) showed a significant (p = 0.007) increasing trend by factors of 444.836 million for 2008–2021. In the Amhara and Somale regions, the poultry population showed a significant (P = 0.000) increasing trend by factors of 549897 and 19631 million, respectively, for 2008–2021. For the years 2008-2021, the poultry population in the SNNP Region increased by a factor of 115412 million (P = 0.233). In Tigray, Dire Dawa, and Harar regions, the poultry population showed a significant (p 0.0001) increasing trend by factors of 220246, 5485, and 6475, respectively, for 2008–2021. For the period 2008-2021, the poultry population in Benshangul-Gumuz increased by a factor of 55141 million (p = 0.019). For the period 2008-2021, the poultry population in the Gambella region increased by a factor of 13792 million (p = 0.014). For the period 2008-2021, the poultry population in the Afar region increased by a factor of 7807 million (p = 0.047).

However, the distribution of poultry populations by region is not uniform. The Oromia region has the most poultry, followed by Amhara, the South Nation and Nationality People of Ethiopia (SNNP), and Tigray. This is due to the availability of commercial poultry farms. Most commercial poultry farms are located close to the consumption centers around Addis Ababa and Oromia. According to CSA (2021), the reported Oromia, Amhara, and South Nation and Nationality People of Ethiopia regions have about 33.62%, 33.44%, 16.91%, and 12.28% of the total poultry population of the country, respectively. Almost everywhere in these regions, commercial poultry production is expanding, both in terms of the number of operators and the volume of production. The poultry population in each country and across regions is increasing over time

as a result of the expansion of commercial poultry production, increased farmer awareness, extension services, and the introduction, multiplication, and distribution of exotic poultry breeds, all supported by research.

Table 1: Poultry Population by Region in Ethiopia

Years	Oromia	Amhara	SNNPr	Tigray	Benishangul-Gumuz	Gambella	Somale	Dire Dawa	Afar	Harar
2008	14,329,775	12,364,824	7,465,585	4,262,337	708,027	173,844	113,082	56,283	53,856	36,288
2009	13,673,006	12,755,956	6,707,186	3,829,788	774,112	202,105	77,367	48,102	26,519	33,362
2010	15,336,939	12,739,620	8,503,564	4,266,077	820,994	210,332	55,752	51,431	29,369	39,185
2011	18,762,281	14,048,486	10,407,807	4,308,595	1,149,069	303,019	106,114	80,963	67,319	53,277
2012	16,345,099	14,116,725	7,690,931	5,003,126	1,140,816	301,735	113,004	80,345	57,993	43,235
2013	18,850,439	14,610,770	9,732,061	5,242,699	1,305,785	298,849	159,293	83,706	42,951	50,589
2014	19,313,874	14,524,806	10,353,805	5,287,790	1,041,557	344,043	196,396	92,283	124,489	71,697
2015	20,076,129	18,031,121	10,433,773	6,189,848	1,375,326	307387	162,884	86,617	13221	71,419
2016	21,201,122	19,958,894	10,851,155	6,329,501	1,363,061	358,288	177,300	85,318	106,355	74,332
2017	20,408,299	19,961,861	11,197,124	5,735,973	1,249,578	385,768	161,265	102,963	197,825	94,371
2018	19,014,114	17,705,026	10,491,131	6,190,640	1,672,084	301,531	250,418	118,376	215,768	97,690
2019	20,766,720	20,501,879	9,542,274	6,032,251	1,480,468	490,448	250,418	93,444	185,372	76,992
2020	16,668,657	16,827,119	7,347,205	6,317,518	884,660	229,151	354,264	129,575	92,941	104,585
2021	19,160,388	19,060,608	7,813,730	7,000,785	1,155,535	314,680	318,567	122,328	91,562	129,963

Source: CSA, 2008-2021

Table 2: Mann-Kendall Trend Statistics for Poultry Population by Region in Ethiopia for 2008-2021

Region	Zmk	MKStatistics	p-value	Alpha	Sen's slope	Trend
Oromia	0.538	49	0.007	0.05	444836	Increase
Amhara	0.714	65	0.000	0.05	549897	Increase
SNNP	0.253	23	0.233	0.05	115412	Increase
Tigray	0.824	75	<0.0001	0.05	220246	Increase
Benshangulgumuz	0.473	43	0.019	0.05	55141	Increase
Gambella	0.495	45	0.014	0.05	13792	Increase
Somale	0.751	68	0.000	0.05	19631	Increase
Dire Dawa	0.802	73	<0.0001	0.05	5485	Increase
Afar	0.407	37	0.047	0.05	7807	Increase
Harar	0.868	79	<0.0001	0.05	6475	Increase

Figure 1: Ethiopian Poultry Population for 2004–2021
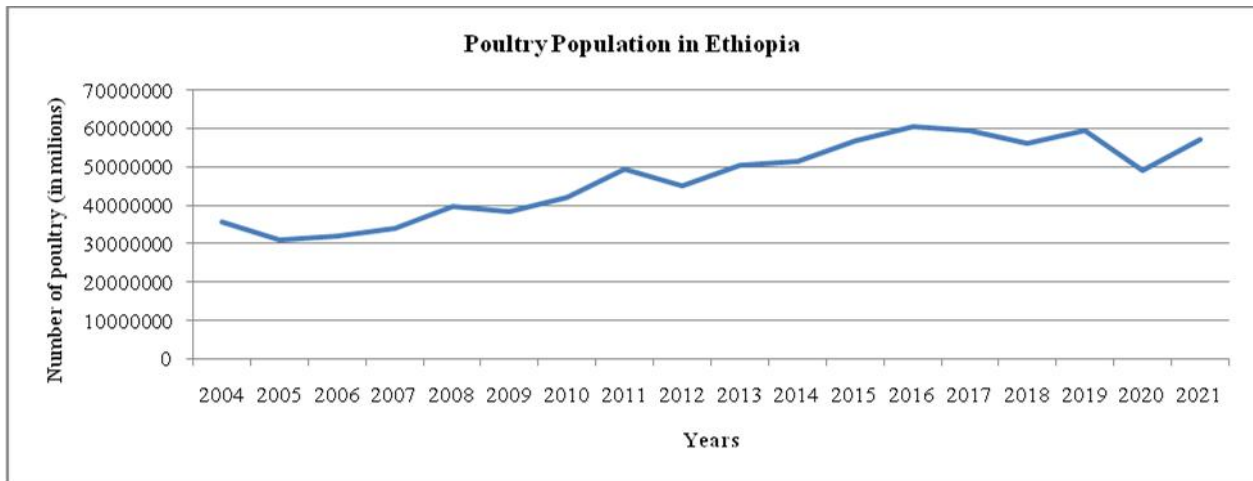
Source: CSA, 2004-2021

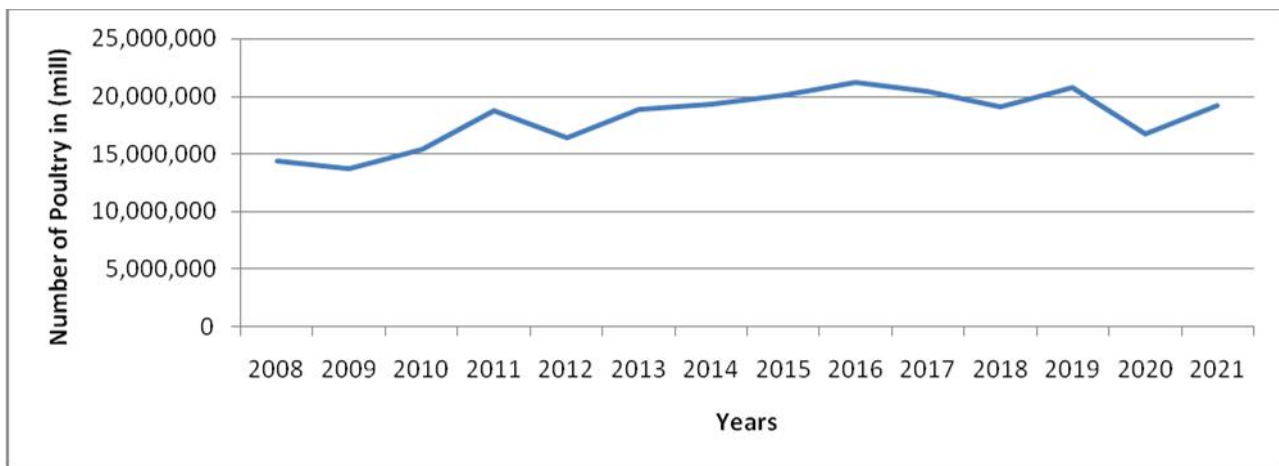**Figure 2**: Poultry population in the Oromia Region from 2008–2021

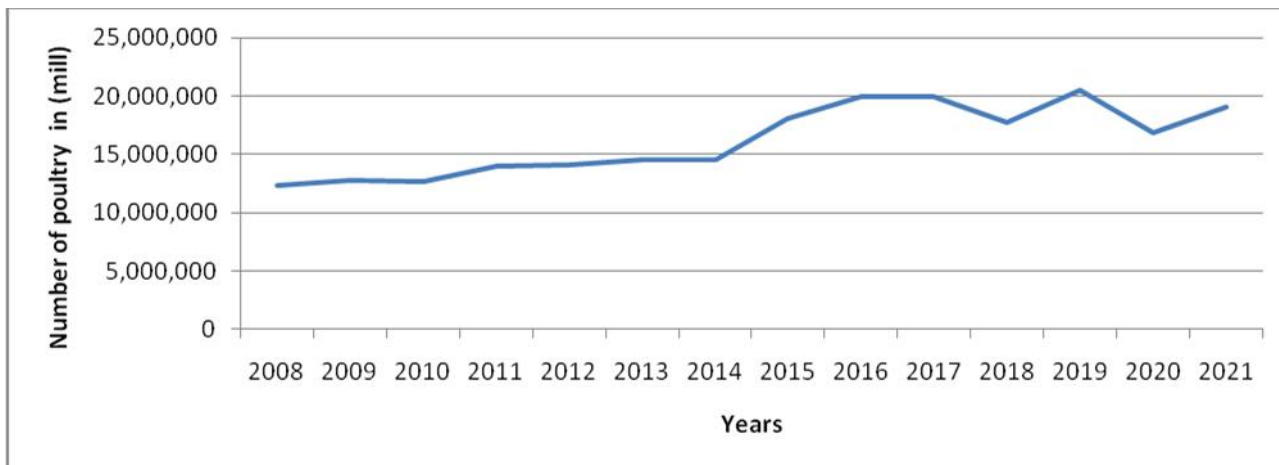**Figure 3**: Poultry population in the Amhara Region from 2008-2021

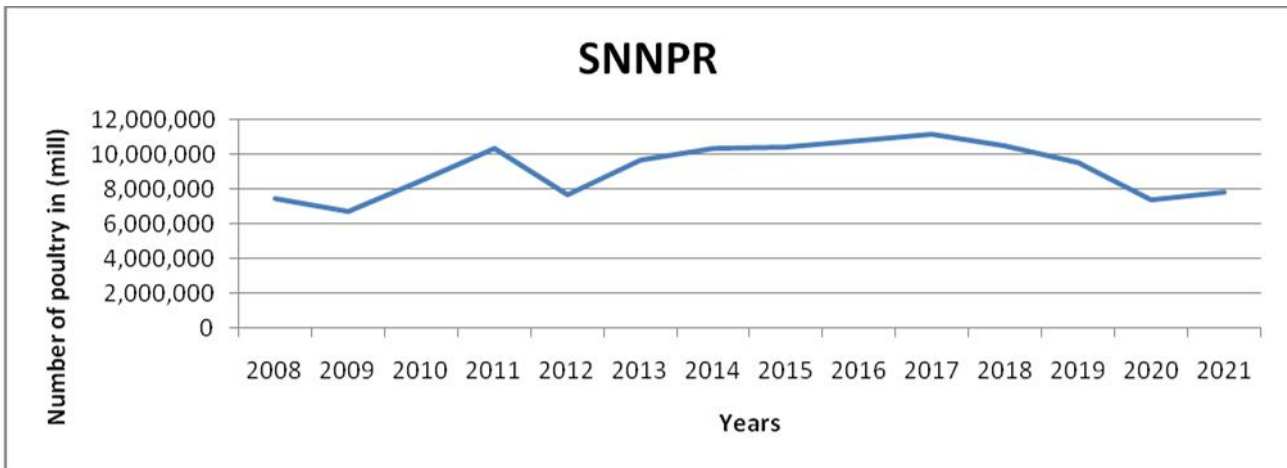**Figure 4**: Poultry Population in the SNNPRegion from 2008-2021

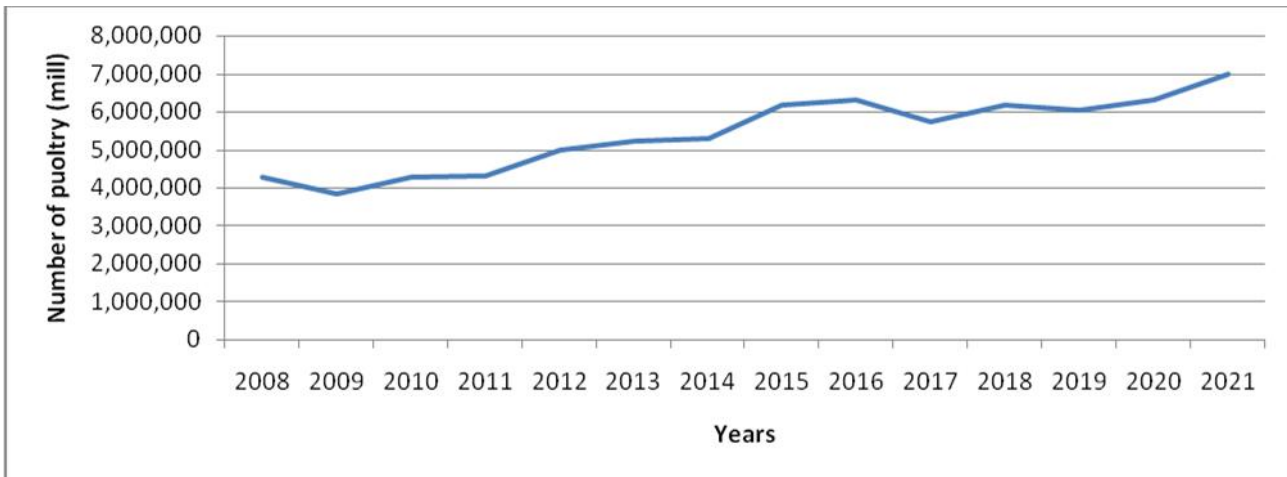**Figure 5**: Poultry population in the Tigray Region from 2008-2021

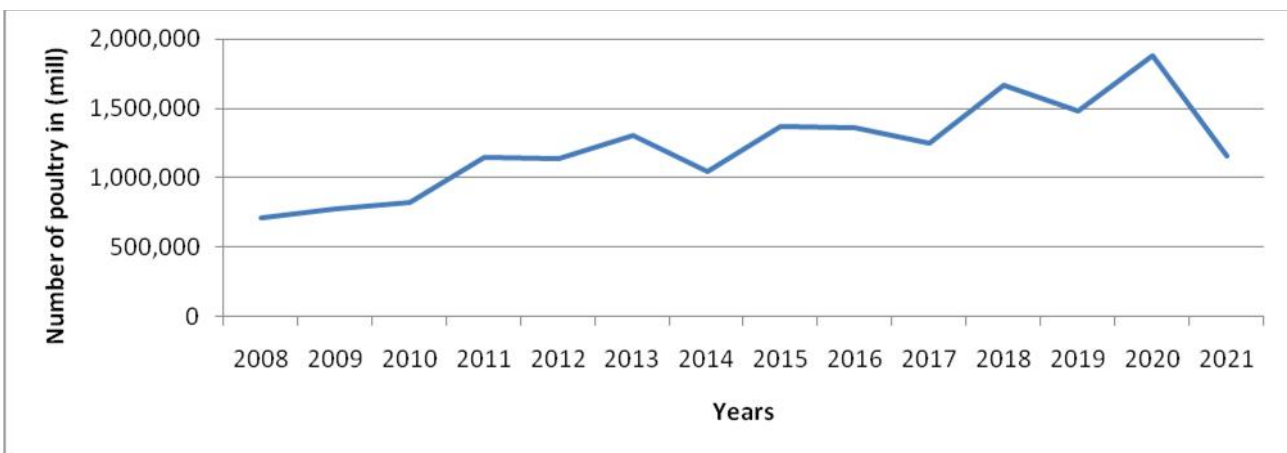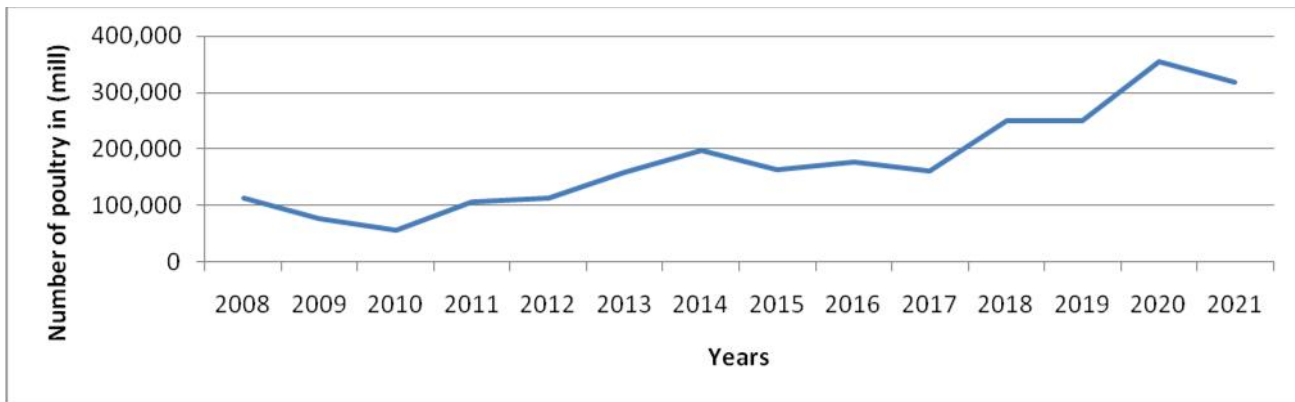**Figure 6:**Poultry population in the Benishangul-Gumuz Region from 2008-2021

Figure 7: Poultry population in the Gambella Region from 2008 to 2021.
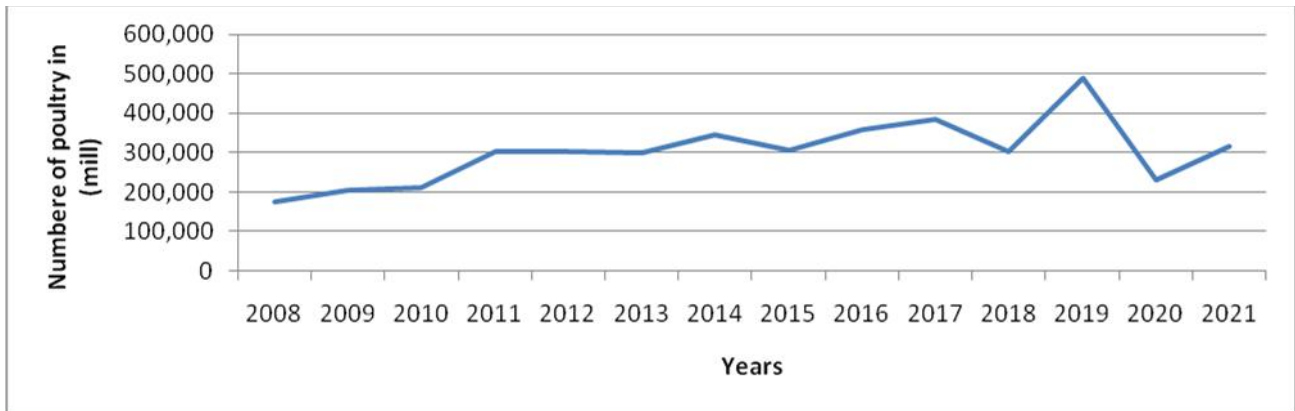
Figure 8: Poultry population in the Somale Region from 2008-2021
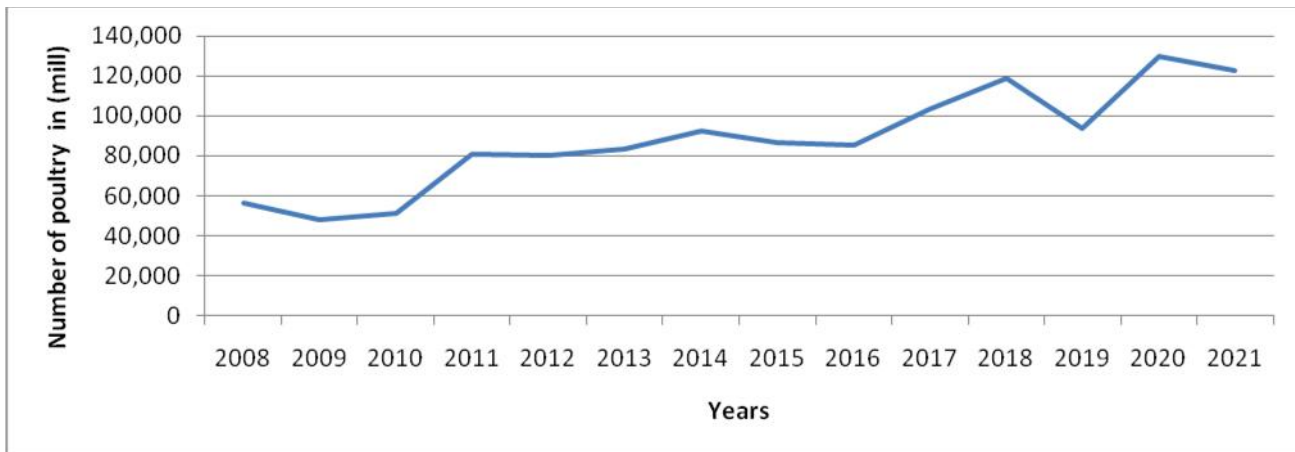

Figure 9: Population in Dire Dawa Region from 2008-2021

Figure 10: Poultry Population in the Afar Region from 2008-2021
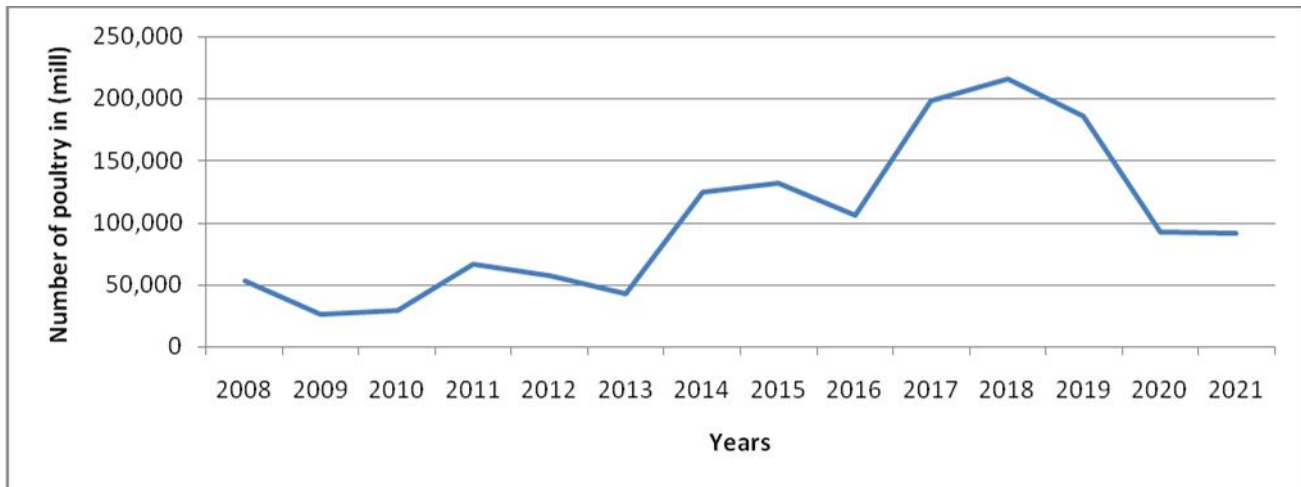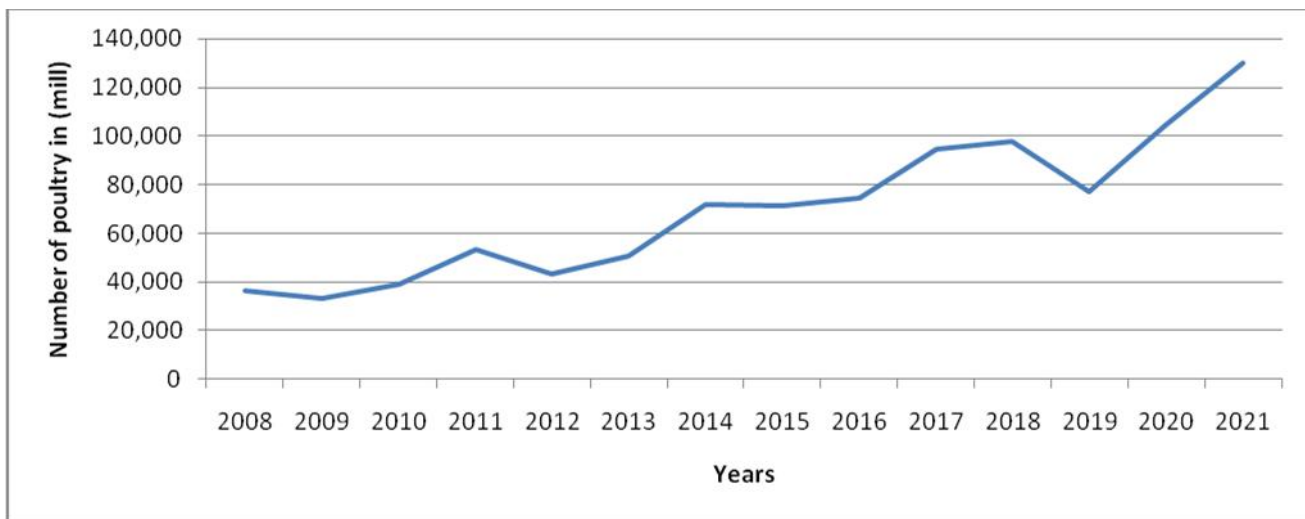

Figure 11: Poultry population in the Harar Region from 2008-2021

Conclusion

Poultry production is one of the key livestock subsectors in Ethiopia. It plays important roles in terms of generating employment opportunities, improving family nutrition, and empowering women. However, the distribution of poultry populations by region is not uniform. The trend shows that Ethiopia's poultry population is growing, and the number of poultry has increased significantly over time. Sen's slope value in Tables 1 to 2 indicated that in Oromia, the poultry population (in millions) showed a significant (p = 0.007) increasing trend by factors of 444.836 million for 2008–2021. In the Amhara and Somale regions, the poultry population showed a significant (P = 0.000) increasing trend by factors of 549897 and 19631 million, respectively, for 2008–2021. For the years 2008-2021, the poultry population in the SNNP Region increased by a factor of 115412 million (P = 0.233). In Tigray, Dire Dawa, and Harar regions, the poultry population showed a significant (p 0.0001) increasing trend by factors of 220246, 5485, and 6475, respectively, for 2008–2021. For the period 2008-2021, the poultry population in Benshangul-Gumuz increased by a factor of 55141 million (p = 0.019).

For the period 2008-2021, the poultry population in the Gambella region increased by a factor of 13792 million (p = 0.014). For the period 2008-2021, the poultry population in the Afar region increased by a factor of 7807 million (p = 0.047).

Recommendation: Based on the above trend, the following recommendations are forwarded:

✓ Government should be establish large commercial poultry farms throughout the regions and expanding it.

✓ Breeding and genetics research in the future should focus on the development of hybrid poultry that is strong against several constraints, rich in nutritional value, and adaptable to new environmental conditions.

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