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Economic Impact of Poultry Disease on Village Chicken production in Ethiopia

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Abstract
Village chickens contribute more than 98% of the total meat and egg productions in Ethiopia. Poultry diseases are considered to be the most important factor responsible for reducing both the number and productivity of chickens and the farmers face huge economic losses throughout the year. The main objective of this study was to assess the economic impact of poultry disease, and its impact on household income, and dietary diversity. The study relied on both primary and secondary data sources of information. The primary data was collected from 152 samples both affected and none affected households. In this study, descriptive statistics, costs and returns analysis, and econometric models were used to analyze the data from households. From the total number of sample households 53.3 percent affected by poultry disease. Only 38% and 23.46% of households affected farm households had access to government veterinary health centers for the treatment of sick poultry to curb the fatal disease for none affected and affected households respectively. The total, cost was estimated at Ethiopian Birr 122836.5 and 105612.5, respectively, for affected and non-affected farm household, and the total return was estimated at 8606.25 and 47880 Ethiopian Birr, respectively for affected and non-affected farm households. The study found that due to poultry disease outbreak an average economic loss was determined 3433.3 Ethiopian Birr for each household. On average, the country incurred an economic loss of 1.58 Billion Ethiopian Birr (US$ 37.656 million) per annum. The household's dietary diversity, showing the score for affected 7.03 and non-affected 9.56 meaning that the affected farm households had consumed less amount than the non-affected farm families. The multiple regression model output shows that age of households, family size, knowledge of poultry disease, training on poultry disease, and access to vaccination significantly affected the income of the household. Thus, control of diseases should be achieved through vaccination and improvement in veterinary and advisory services.

Key words: ***1*** *Economic Impact ,2 Village Chicken, 3Poultry Disease, 4 Affected and Non Affected Households*

1. Introduction

Ethiopia has about 60% of the total chicken population of East Africa, the total poultry population at country level is estimated to be about 48.96 million, most of the poultry is laying hens (36.78 percent), followed by chicks (30.36 percent) and others(32.86 percent). With regard to breed, 81.71 percent, 10.86 percent, and 7.43 percent of the total poultry were reported to be indigenous, cross breeding and exotic, respectively. About 56 percent (9.6 million) of Ethiopian households has poultry holdings with varying range of flock size. However, about 80 percent of the households with poultry, keep from 1 to 9 chickens (CSA, 2020).

These are large commercial, small scale commercial and village poultry production system. Village chickens contribute more than 98% of the total meat and egg productions in the country and 97% of these chickens are maintained under this scavenging production system with no inputs for health care (Alemayew et al, 2015).
In Ethiopia, however, lack of knowledge about poultry production, limitation of feed resources, prevalence of diseases (Newcastle, Coccidiosis, etc.) as well as institutional and socio-economic constraints remains to be the major challenges in a village based chicken productions (Yohannes et al, 2020).

The major causes of this problem as perceived by the community and in their order of importance were disease (63.8 %), predation (21.8 %), lack of feed (9.5 %) and lack of information (4.9%), as per the reports of (Tadelle , 2003). According to Tadelle and Ogle (2001), the primary problem cited by the village poultry farmers was high mortality of chicks.

Many reports showed that Newcastle disease (ND), Infectious Bursal disease (IBD) or Gumboro, Marek disease (MD), Fowl typhoid, Cholera, Mycoplasmosis and Coccidiosisare widely distributed in most African countries, Ethiopia is not exception to this situation (Alem,2014). The Ethiopian indigenous flocks are said to be relatively disease resistant and adapted to their environment. However, survival rates of chicks kept under natural brooding conditions is considered to be very low.

Losses attribute to Newcastle disease is estimated at about 57.3% of the overall annual chicken mortality, whereas fowl pox, coccidiosis, and predation accounts for about 31.6%, 9.4%and 1.7% of the total annual flock mortality respectively. A survey conducted in Southern Ethiopia identified Fowl cholera followed by New Castle Disease, Coccidiosis, Fowl influenza (Infectious Bronchitis), Fowl pox, Fowl typhoid and Salmonella to be the major poultry diseases respectively(Bereket et al,2014)

The general indications are that the health status of the backyard poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control, and chickens freely roam in the compounds used by households and children. There are no practices (even means) of isolating sick birds from the household flocks and dead birds could sometimes be offered or left for either domestic or wild predators. The limitation of veterinary services such as drug, vaccine and consultancy to the rural farmers is the gaps for the occurrence of the loss due to diseases and predators (Tadele, 2015)

Infectious and parasitic diseases affecting livestock remain important constraints to profitable livestock operations in Ethiopia. This adversely affects animal welfare and often has major impacts upon human health and public perception of livestock product. The costs of existing endemic diseases are estimated to be 35 to 50 % of the turnover of livestock in the developing world (Whitelaw and Sang 2005).

In Ethiopia, poultry diseases are considered to be the most important factor responsible for reducing both the number and productivity of chickens. In the year 2019/2020 alone, 18.61 million (38.01 percent) poultry died of diseases (CSA 2020). Studies indicate that poultry diseases such as Newcastle disease, Infectious bursa disease (IBD), and coccidiosis are endemic in village poultry and are believed to cause huge economic losses to village poultry keepers in rural Ethiopia (Gari et al. 2008).

Poultry diseases are accountable for a number of adverse economic and social impacts. Their occurrence depends on various factors, including Geo-climatic condition, population density, management practices, and immunization status (Al Mamun and Mehetazul 2019). They lead to high mortality and morbidity of chickens, high medication costs, loss in production and market, and can pose a risk to public health through zoo noses (Wubet et al. 2019). Hence, poultry disease status, poultry morbidity, and mortality are useful, measurable indicators to judge the overall health status of a flock and its productivity (Marangon and Busani, 2007). But there is no detailed research work regarding the economic loss for poultry Village Chickens in Ethiopia.

2. Methodology

2.1 Description of the Study Area

The study was conducted in the Southern Gondar zone in three districts during 2020/21 cropping season. The South Gonder Zone is located in a temperate ecologically about 645 km from Addis Abeba and 123 km south east of Bahir Dar town in North West Ethiopia. The topography in south Gondar zone consists of complex features of landscapes comprising of flat to gentle slope, hilly and mountainous topography. According to the Ethiopian agro-climatic classification, it is classified into four, kola, 'Dega, wurch and Weyna dega agro-climatic zones. The mean annual temperature is about 15.94 0C, ranging from a mean minimum of 8.425 0C to mean maximum of 23.4580C. The mean annual rainfall is 161.4 mm /year, with high variation from year to year (SGZAD, 2021).

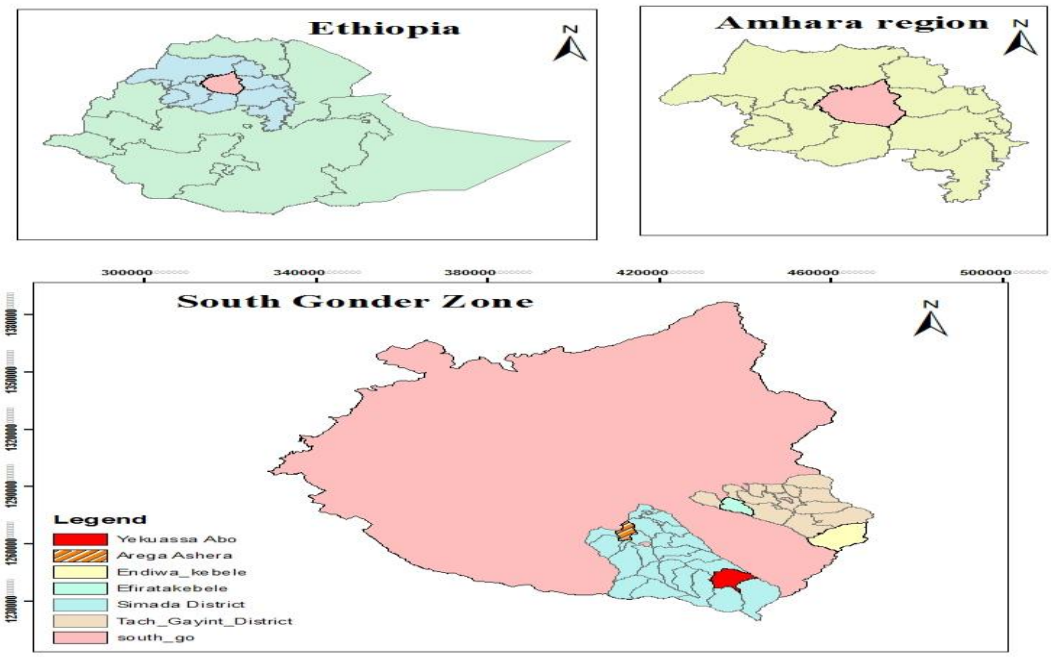

Figure 1. Location map of study districts

2.2 Source and Methods of Data Collection

For In this study, both qualitative and quantitative data were used. The study relied on both primary and secondary data sources of information. The qualitative data collected through individual interview using checklists, focus group discussions; key informant interview conducted with each word animal health staff members to gather sufficient information and to capture relevant data from the beneficiaries. Four FGDs that contains 7-8 members were conducted in the sample kebeles and five key informants were also in contact with the staff members of animal production and health agency to get information about how the office is operating in the area and about the disease and control intervention. The quantitative and qualitative data were collected through a survey using interview schedule. Characteristics' of households, income from chicken affected and None Affected household, education, family size, knowledge on poultry disease, disease transfer, poultry production experience, training on poultry disease, disposal of dead chicken and household's vaccination participation, mortality, morbidity, vaccine cost, medicine, veterinary service cost, feed, labor, and housing are quantitative and quantitative data was collected through a household survey using an interview schedule

3.3 Sample Size and Sampling Procedure

For the primary data collection, a multistage sampling technique was used to draw the sample First stage; the recommendation of the animal health Experts of the zone, two districts were purposely selected in the zone. In the second stage, four kebeles were selected from the districts based on disease infection. The third stage, using the household list of the sampled *kebeles sample farmers was selected randomly based* on probability proportional to the size sampling technique of the selected *kebeles*. In this regard, the sample population was categorized into affected and none affected and they were sorted alphabetically to use random tables, and then the appropriate sample sizes were determined. Based on the household, the number of the Kebeles 81 affected and 71 none affected farmers' altogether 152 respondents were randomly selected by using the formula (Cochran, 1963:75).

$$n_o = \frac{Z^2 pq}{e^2}$$

$n = \frac{1.96^2(0.3)(0.7)}{0.7^2}$=152

Table 1 Sample size of households

Sample districts	Sample Kebeles	Total Number of population	Total number of affected households	Total number of non affected households	Total Sample size
Tach Gaint	**Endwa**	1107	719	388	41
	Efrata	1095	711	384	39
Simada	**Yekuwasa Abo**	840	545	295	30
	Arga Ashera	1092	709	383	42
	Total	4134	2684	1450	152

2.4 Method of Data Analysis

In this study, descriptive statistics, profitability analysis, and econometric models were used to analyzing the data from farmers.

2.4.1 Descriptive analysis

The basic approach was used to assess the relative impact of poultry disease involves a comparison between the affected and none Affected using descriptive statistics. Descriptive statistics such as mean, standard deviation, percentage, t and χ 2 was employed to compare the changes in relevant parameters of the affected and None Affected user groups.

2.4.2 Cost and Returns Analysis

Cost and return analysis was used on both variable and fixed cost basis. The following profit function will be used to assess the profitability of village chickens farming (Khatun, et .al, 2018).

The profit function, $P = PpQp + PEQE - \Sigma Pixi - TFC$

Where,

P = Profit or loss per farms

Pp = Per unit price of live village Poultry

PE= Per unit price of used litter and excreta

Qp= Quantity of live village Poultry

QW= Quantity of waste litter

PVi = Per unit piece of ith (variable) inputs

Vi = Number / quantity of ith inputs

TFC = Total fixed costs.

Overall Economic Loss determination: Economic loss was determined to compare direct loss and indirect loss. The direct loss was determined by summation of the value of chicken which died due to chicken disease attacked and handling cost (medication & vaccine and health officer's fee). On the other hand, the indirect loss was determined by adding up two components that mean extra time exhausted on taking care of affected chicken and output loss such as less egg lying (Khatun, et .al, 2018). The formula is written as follows.

Overall Economic Loss (OEL) = Direct Loss + Indirect Loss

Direct Loss = Value poultry (dead) + Handling Cost (medication & vaccine and health officer's fee)

Indirect Loss = Extra time exhausted for taking care of affected poultry + output loss such as less egg-laying

So, Overall economic Loss = Value poultry (dead) + handling Cost (medication & vaccine + health officer's fee) + extra time exhausted for taking care of affected poultry + output loss such as less egg-laying

OEL = VP+ HC + ETCAP + OL

Where OEL-Overall Economic Loss

VP-Value of Dead Poultry

ECAP- Extra Time Take Care of Affected Poultry

OL-Output Loss

2.4.3 Econometrics analysis

To measure factors affecting the household income and the household dietary diversity, a linear regression model was employed. A number of households and institutional factors are identified as the main features that affect the household income and the household dietary diversity. This model was chosen for a reason that the dependent variable i.e. income and dietary diversity is continuous (Gujarati, 2003), and other assumptions of OLS are fulfilled in the field survey data. Moreover, different studies on the household income and the household dietary diversity used Ordinary Least Square (OLS) regression to assess determinants of the household income and the household dietary diversity (Kinde, 2007; Betelihem, 2013; Mahilet, 2013). Therefore, the study chooses a linear regression model to analyze the major causes of the household income and the household dietary diversity. The independent variables were the age of household head, sex of household head, education, family size, years of experience in poultry production, knowledge of poultry disease, disease transfer, training, access to vaccination, and Distance to the nearest health center. Multiple regression models could be written as:

$Y_i = \alpha + X_i\beta + U_i$ (1)

Where Y_i = is the household income from cross bread, chicken and the household dietary diversity

X_i = explanatory variables determining the household income and the household dietary diversity

α = intercept

β = coefficient of i th explanatory variable

U_i= unobserved disturbance term

Dependent variable

Household income from the village chicken: cash inflow streams those are poultry sold, egg sold, poultry and egg consumption in the family and gift or donation of chicken to relatives or to others (Ethiopian Birr)

Households dietary diversity score: smallholder farmers dietary diversity, showing the items from food pulses, oilseeds, vegetables, root crops, permanent crops, milk, meat, egg, alcohols drinks, soft drinks, and others

Explanatory variable

Table 2 Definitions, measurements and signs of explanatory variables

Code	Variable proportion	Variable type	Measurement	Expected sign
HHST	House hold Status	Dummy	1=affected,0=non affected	-
HHAGE	Age of household head	Continuous	Number of years	+
HHSEX	Sex of households	Dummy	1 male ,0 female	-/t

EDHH	Education of level	Continuous	Year	+
HHFS	Household size	Continuous	Number of man equivalent	+
KNPD	Knowledge on poultry disease	Dummy	1=yes,0=otherwise	+
DT	Disease transfer	Dummy	1=yes,0=otherwise	-
HHE	Year of experience	Continuous	Number of year	+
DTRHC	Distance to the nearest to health center	Continuous	Kilometer	+
TT	Training	Dummy	1=yes,0=otherwise	+
VACCI	Access of vaccination	Dummy	Vaccination frequency	+

3. Results and Discussions

3.1. Current Poultry Disease Status of the sample Households

Household survey participants were asked whether their chicken had been dead in the last 12 months prior to the interview. Then, the poultry that died by disease was defined as "yes" responses when respondents answered "yes" and the poultry not died by disease was defined as "no" responses. From the total 152 sample household 71 were found to be not affected by poultry disease and only 81 households were not affected by poultry disease. In other words, 53.3 percent and 46.7 percent of the sample households were affected and none affected, respectively

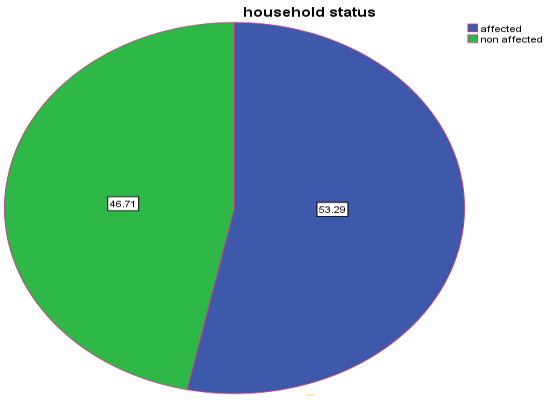

Figure 2 the Status of Households Affected By Poultry Disease

3.1 Smallholder Farmer's Characteristics

3.1.1. Age of the household head

The assumption here was that the higher the age of the household head, the better the None Affected situation as there can be more options of making vaccination and protection, from both farm and non-farm opportunities in addition to the wealth of experience in the farming system. From the survey result, it became apparent that increasing the age of household heads was decreasing the death of chicken status and increasing consumption. In fact, in the present study, it is found out that there is significant difference between the mean age of the affected and None Affected households. The mean household age for the affected

and none affected is 50.24 and 43.20 years, respectively. The overall mean age of the household heads for the study area stands at 46.5. This result, which disagrees with the expectation, might be explained by the fact that the elderly household heads are more reactive to the changing production environment and the wealth of experience in the farming system. It is, therefore, found from the study that the increased age of households' heads implies the decreased risk of poultry disease.

Table 3 . Distribution of sample household by age

Age distribution	Non affected (71)		Affected (81)		Total (152)		t-value
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
≤35	8	11.27	27	33.33	35	23.03	
36-50	31	43.66	35	43.21	66	43.42	
51-64	25	35.21	13	16.05	38	25.00	
≥65	7	9.86	6	7.41	13	8.55	
Mean	50.24		43.20		46.50		
S.D	10.93		12.07		12.04		
Minimum	30		20		20		
Maximum	75		73		75		3.79**

Significant at 5% probability level

3.1.2. Educational level of the household head

Survey indicated that most household heads in the surveying district were illiterate. From the total sample, 61 (40.13 %) of the households were illiterate and, from thus 43 (53.09%) Affected by poultry disease and 18 (11.92%) non affected household and, only read and write, affected 20 (24.69%), non affected 26 (36.62%) totally 46 (30.26%).In table 4 sample survey indicates that from grade 1-6 affected 11 (13.58%) ,non affected 17(23.94%) ,grade7-8 affected 4(4.94%), non affected 5(7.04%) , grade 9-12 affected 3(3.70%), non affected 5(7.04%), and the total percentage of 28(18.42%),9 (5.9%),8(5.26%) grade 1 -6, grade7-8 and grade 9-12 respectively, these indicate that the more the educational level of the household head, the less the possibility of household to affected family were high so that the less the educational level of the household head more possibility the household to become affected by poultry disease.

Table 4. Distribution of household head by educational status

household head Education level	Non affected (71)		Affected (81)		Total (152)		t-value
	Frequency	%	Frequency	%	Frequency	%	
Illiterate	18	25.35	43	53.09	61	40.13	
Read & write	26	36.62	20	24.69	46	30.26	
grade 1-6	17	23.94	11	13.58	28	18.42	
grade 7-8	5	7.04	4	4.94	9	5.92	
grade 9-12	5	7.04	3	3.70	8	5.26	
Total	72	100.00	79	100.0	151	100.00	3.135**

**Significant at 5% probability level

3.1.3 Knowledge on poultry disease: knowledge of poultry disease was one of the factors that affect poultry production, because more knowledge about poultry disease may be reduced poultry mortality. According to the survey, 46.05 percent of the sample households have knowledge of poultry disease. Accordingly, 78.87 %

of those affected and 17.28 % of the affected have knowledge of poultry disease. There is a significant difference in knowledge on poultry disease between affected and none affected at a 1% significance level (Table 5). The result implies that the lack of knowledge about poultry disease, the more probability of affected by poultry disease.

Table 5. Distribution of sample respondents by knowledge of poultry disease

Knowledge on poultry disease	Non affected (71)		Affected (81)		Total (152)		x^2
	Number	Percent	Number	Percent	Number	Percent	
Yes	56	78.87	14	17.28	70	46.05	
No	15	21.13	67	84.72	82	53.95	
Total	71	100	81	100	152	100	14.43***

***Significant at 1% probability level.

3.1.4 Family size

According to Table: 6 the size of household, the survey data has revealed that among respondents, those with household size less than 3 accounts for 19 (26.76%) and 17(20.99%) were found to be non-affected and non-affected households respectively, and although, Respondents whose household size is 4-6 account for 43 (60.56%) and 32(39.51%) of affected and non affected respectively. Respondents whose household size is 7-9 account for 9 (12.68%) affected and 24 (29.63%) none affected but, with household family size greater than 10 only affected households were listed in the table. The mean and Std. Dev of none affected households is 4.53 and 1.539 respectively, and, for affected 6.10, and 2.65 respectively.

This means that the higher the family size, measured in the study area, the more it is related to the affected status of the households in the study area. Therefore, the distribution of sample households with regard to household family size, measured in the living condition of household, show a statistical difference between affected and non-affected households this shows that a more family size household prone to affected than small number household.

The participant's observation of the focus group discussions stated the situation of family size has a direct and negative effect on affected by poultry disease. However, families who have a large number of family sizes could not be able to manage the feed of poultry.

Table 6 . Poultry disease Status by family size

Family	Non affected (71)		Affected (81)		Total(152)		t-value
Size	Frequency	Percent	Frequency	Percent	Frequency	Percent	
≤3	19	26.76	17	20.99	36	23.68	
4-6	43	60.56	32	39.51	75	49.34	
7-9	9	12.68	24	29.63	33	21.71	
≥10	-		8	9.88	8	5.26	
Mean	4.53		6.10		5.35		
Std. Dev	1.529		2.653		2.321		-4.408
Minimum	2		2		2		
Maximum	8		12		12		

Note: ** Significant at 5% probability level

3.1.5. Sex of household heads

From the 152 respondents, 19 (17.11%) were female-headed respondents whereas 133 (82.89%) were male-headed household respondents. Among the None Affected households 10 (14.1%) were female-headed and 61(85.90%) were male-headed households while the Affected households 16(19.8%) and 65 (80.2%) were female and male-headed households respectively. It was hypothesized that male-headed households are more likely to be None Affected than female-headed ones, because female-headed households have more working experience than male-headed households. The survey result showed a statistically significant difference between male and female None Affected and Affected household heads.

Table 7. Distribution of sample household heads by sex of household heads

Sex of respondents	None Affected(71)		Affected(81)		Total(152)		X^2-value
	Number	Percent	Number	Percent	Number	percent	
Male	13	18.31	64	79.01	77	50.65	
Female	58	81.69	17	20.99	75	49.35	
Total	71	100	81	100	152	100	12.68***

*** Significant at 1% probability level

3.1.6. Disease Transfer: Chickens don't take the vaccination**;** the disease may be transferred to other health poultry. According to the survey, 43.42 percent of the sample households affected by disease transfer to other healthy chickens. Accordingly, 81.48 % of the affected households have incurred an additional loss by transfer of disease to other healthy chickens. There is a significant difference in saving behavior between affected and none affected at a 1% significance level (Table 8). The result implies that the more disease transfer, households loss other healthy chickens.

Table 8. Distribution of sample respondents by Disease transfer

Disease transfer	None Affected(71)		Affected(81)		Total (152)		x^2
	Number	Percent	Number	Percent	Number	Percent	
Yes	-	-	66	81.48	66	43.42	
No	71	100	15	18.52	86	56.58	
Total	71	100	81	100	152	100	23.36***

***Significant at 1% probability level.

3.1.7. Training: households who have access to training on poultry disease treatment and disposal are more likely to benefit from poultry production than no access one. Survey, 50.65 percent of the sample households have access to training for different organizations. Accordingly, 88.73% of non-affected and 17.28 % of the affected households have got training access. There is a significant difference in access of training between affected and none affected at a 1% significance level (Table 9).

Table 9 Distribution of sample respondents by Access of Training

Training	Non Affected(71)		Affected(81)		Total (152)		x^2
	Number	Percent	Number	Percent	Number	Percent	
Access of training	63	88.73	14	17.28	77	50.65	
No access of training	8	11.27	67	82.72	75	49.35	
Total	71	100	81	100	152	100	14.68***

***Significant at 1% probability level.

3.1.8. Distance to the nearest health centres

Households nearer to the office of veterinary health center have a better chance to improve the health of chicken status than those who do not have proximity to the office of veterinary health centers. Proximity to the office of veterinary health centers was measured in kilometers. Due to this survey result, the mean distance of None Affected was nearer to the veterinary health center than Affected household. Consequently, the survey result showed that the mean distance exhibits a statistically significant at a 5 % probability level.

The mean distance to the nearest to the office of the veterinary health center of sampled households of None Affected was 4.97 km and Affected was 11.66 km. The overall mean distance to the office of the agricultural extension was 8.47 km.

Table 10 Distribution of sample households by distance to nearest health center

Distance to the nearest health center	Non affected (71)		Affected (81)		Total (151)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
≤ 3k.m	45	63.38	15	18.52	60	39.47
4-9k.m	10	14.08	9	11.11	19	12.50
10-15k.m	15	21.13	40	49.38	55	36.18
>15 km	1	1.41	17	20.99	18	11.84
Mean	4.97		11.66		8.47	
S.D	5.36		5.22		6.30	
Minimum	3		3		3	
Maximum	18		19		19	
t-value					-7.71	

** Significant at 5% probability level

3.1.9. Year of experience: Experience in poultry production varied among the sample households from a minimum of 0-year experience to a maximum of 21 years of experience. Non-affected participated on the average for the higher number of years 18.65 as compared to the affected who participated on average for 7.15 years (Table 11). The mean difference between the two groups was significant at 5% level of significance. That is, farmers' experience in poultry production has a significant role in the treatment of poultry disease.

Table 11. Experience of poultry production by household's status

Experience on Poultry production	None affected (71)	Affected(94)	Total (152)	t-value
Mean	18.65	7.15	15.23	5.25**
SD	12.3	3.42	10.41	
Minimum	5	0	0	
Maximum	21	10	21	

** Significant at 5% probability level.

3.1.10. Farmers' get treatment of facility

Farmers had taken treatment from various sources in the study areas such as government veterinary health centers, universities (community service), and private veterinary health centers. Only 38% and 23.46% of households had access to government veterinary health centers for the treatment of sick poultry to curb the fatal disease for none affected and affected households respectively.

Table 12 .From where Farmers Get Treatment Facilities

Institution	**Non affected (71)**		**Affected (81)**	
	Number	**Percent**	**Number**	**Percent**
Government Veterinary health center	27	38	19	23.46
Universities	5	7.04	2	2.47
Private veterinary health center	19	26.76	11	13.58
No service	20	28.2	49	60.49

2.2. Cost and Returns Analysis

2.2.1. Production cost of village chicken

Costs are the spend expenditure for operating and managing the production system. The cost of production comprised of various variable cost items like medication and health officers cost, feed cost, labor and shade preparation cost, and disposal cost. Both cash expenditure and imputed value of family-supplied inputs were included. The feed was the major cost item incurred by the affected and non-affected both. Feed cost was estimated for 9 poultry per year Ethiopian Birr (ETB) 109350 and 95850 for affected and non-affected farm household, respectively, and those were 89.02% and 90.76 % of the total cost. The total cost was estimated at ETB 122836.5 and ETB 105612.5, respectively for affected and non-affected farm household

Table 13 Production cost of village chicken

No	Costs	9 poultry / year			
		Non affected (71)		Affected (81)	
		Birr	Percent	Birr	Percent
1	medication and health officers cost	958.5	0.91	1093.5	0.89
2	Feed cost	95850	90.76	109350	89.02
3	Labor cost	4970	4.71	7290	5.93
4	Shelter	3834	3.63	4374	3.56
5	Disposal cost			729	0.59
	Total	105612.5	100.00	122836.5	100.00

2.2.2. Return from village poultry

The study identified some cash inflow streams those were poultry sold, egg sold, poultry, and egg consumption in the family of chicken to relatives or to others. Among those cash inflow streams to the household income, poultry consumption was calculated highest for the followed by poultry sold both in affected and non-affected farm families. Total return was estimated at 8606.25 and 47880 Ethiopian Birr, respectively for affected and non-affected farm households.

Table 14 Returns from village poultry production

No	Income item	Non affected (71)		Affected (81)	
		Birr	Percent	Birr	Percent
1	Poultry sold	18105	37.81	5163.75	60
2	Egg sold	3150	6.58	0	0
3	Poultry consumption	24140	50.42	3442.5	40

4	Egg consumption	2485	5.19	0	0
	Total	47880	100.00	8606.25	100

2.2.3 Household incurred an economic loss due to poultry disease outbreak

In this study, due to a poultry disease outbreak, the average economic loss was determined to Ethiopian Birr (ETB) 3433.33 per household per annum, and the average of nine poultry birds were forgone per household per annum. In the year (2020), 53.3 percent of the household was affected by poultry disease. On average, we estimated, the country incurred economic loss Ethiopian Birr (ETB) 18,606,521 chickens *85ETB = (1581554285 ETB) or (US$ 37656054.41) per annum.

Table 14 Household incurred an economic loss due to poultry disease outbreak

Loss (ETB)	**Endwa (19)**	**Efrata(23)**	**Yekuwasa Abo(21)**	**Workaye (18)**	**Total (81)**	**Average**
Loss (direct)	14791.5	17905.5	16321.5	14026.5	63045	15761.25
Loss(indirect)	50445	61065	55755	47790	215055	53763.75
Total Loss	65236.5	78970.5	72076.5	61816.5	278100	3433.33
Death poultry (No.)	171	207	189	162	729	9

2.2.4 Impact on household dietary diversity

The study found an adverse impact on household dietary diversity showing the score for affected 7.03 and non- affected 9.56 meaning that the affected farm households had consumed less amount than the non-affected farm families because the affected household had got less income or incurred loss due to chicken died for poultry disease attacked. They also faced a problem of the safe family-supplied chicken because the chicken was infected by poultry disease.

Table 14 Impact on household dietary diversity

Food category	**Non affected (71)**	**Affected(81)**
Cereals	156	185
Pulses	134	179
Oilseeds	98	113
Vegetables	74	104
Root crops	78	146
Permanent crops	67	97
Milk	54	75
Egg	85	108
Meat	72	99
Fish	42	21
Soft drink	33	68

Alcohol drink	109	123
Others	76	88
Average (Household Dietary Diversity)	9.56	7.03

2.3 The factors influencing on household's dietary diversity and income

2.3.1The factors influencing on household's dietary diversity

In total, ten independent variables that are hypothesized to have influence on household dietary diversity in the study area was included in the model, of which 4 were found to be statistically significant which were the sex of household head, educational level, Disease transfer, and years of experience on poultry production.

Table 15 Coefficients of household dietary diversity score

Variables	Coefficients	Standard deviations	t-value	P>|t|	Marginal Effect
HHAGE	-0.0237498	0.1105069	-0.21	0.830	-0.001
HHSEX	0.0083766	0.0032401	2.59**	0.011	0.044
EDHH	0.0712199	0.0304471	2.34**	0.021	-0.033
HHFS	0.0470138	0.0300923	1.56	0.121	0.003
KNPD	0.0349461	0.0351528	0.99	0.322	0.020
DT	-0.0224838	0.0057925	-3.88***	0.000	-0.021
HHE	0.1951986	0.0481676	4.05***	0.000	0.019
DTRHC	-0.2238859	0.360554	-0.62	0.536	-0.004
TT	0.0916448	0.0667852	1.37	0.172	0.011
VACCI	0.0822399	0.2688321	0.31	0.301	0.001
-constant	0.0349542	0.0698055	0.50	0.617	0.008

***, ** represents level of significant at 1% and 5% respectively

2.3 The factors influencing on household's dietary diversity and income

2.3.1The factors influencing on household's dietary diversity

In total, ten independent variables that are hypothesized to have influence on household dietary diversity in the study area was included in the model, of which 4 were found to be statistically significant which were the sex of household head, educational level, Disease transfer, and years of experience on poultry production.

Table 16 Coefficients of household income

Variables	Coefficients	Standard deviations	t-value	P>|t|	Marginal Effect
HHAGE	0.1002498	0.0402186	2.49**	0.014	0.0101
HHSEX	-0.0360585	0.0452026	-0.80	0.426	-0.0137
EDHH	-0.020501	0.2926379	-0.07	0.944	-0.0010

HHFS	-0.1996525	0.0502136	-2.25**	0.026	0.0048
KNPD	0.0797857	0.0141761	5.63***	0.000	0.1145
DT	0.070666	0.0699991	1.01	0.314	0.0167
HHE	0.019543	0.0204261	0.96	0.340	0.0045
DTRHC	1.06e-06	3.69e-06	0.29	0.775	0.0021
TT	0.0151076	0.0045716	3.30***	0.001	-0.0256
VACCI	0.1375431	0.0554444	2.48**	0.014	0.0042
-constant	-0.1714944	0.1358937	-1.26	0.209	-0.0068

***, ** represents level of significant at 1% and 5% respectively

4. Conclusion and Recommendations

4.1. Conclusion

Poultry diseases are accountable for a number of adverse economic and social impacts. Only 38% and 23.46% of households had access to government veterinary health centers for the treatment of sick poultry to curb the fatal disease for none affected and affected households respectively. In the year 2019/2020 alone, 18.61 million (38.01 percent) poultry died of diseases. The country incurred economic loss1.58 Billion ETB (US$ 37.65 million dollars) per annum.

The household dietary diversity showing the score for affected 7.03 and non-affected 9.56 meaning that the affected farm households had consumed less amount than the non-affected farm families because the affected household had got less income or incurred loss due to chicken died for poultry disease attacked.

The multiple regression model output shows that sex of household head, educational level, and years of experience in poultry production were significantly affect households dietary diversity score and age of households , family size, knowledge of poultry disease, training on poultry production, and access to vaccination were significantly affected households' income.

4.2. Recommendations

Based on the findings of this study the subsequent recommendations are

- Private investors should participate in the establishment of a veterinary health center so as to improve the health of livestock species with standard quality and a minimum price
- Government should strengthen poultry extension, research, and education to develop communities awareness towards poultry contribution in life
- Control of diseases should be achieved through vaccination and improvement in veterinary and advisory services.
- Training for farmers and extension staff focusing on disease control, improved housing, and feeding, marketing systems could help to improve productivity of village chicken.

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