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WATER QUALITY ASSESSMENT FOR DRINKING PURPOSE AS AN IMPLICATION TO HUMAN HEALTH IN ARSIS AREA, AFAR, NORTHEASTERN ETHIOPIA

Hindeya Gebru[1*], Temesgen Admas[1], and Mohammed Ahmed[2]

ABSTRACT

Safe water is a prerequisite for human health and any developmental activities. Water-related diseases are caused by insufficient safe water quality and quantity. The study area is located in the east-central Afar depression which affected mainly by salinity and fluoride. The main objective is to investigate the water quality of the area as an implication for human health. The exposed lithologies of the area are consist of basalt, scoriaceous basalt, and alluvial deposits. These are affected by normal faults with NNE-SSW and NNW-SSE orientation. A total of three water samples are collected from spring, borehole, and river water points and analyzed for about 31 parameters. As a result, the spring water has very low water quality followed by borehole but the river water is freshwater and portable for domestic uses. The long-term effect of the spring water can be kidney and heart diseases, laxative and constipation effects, cardiovascular disease, kidney damage and disinfection, hypertension, headache, coronary artery disease, diabetes, adrenal insufficient, and hyperkalemia. The water types of the springs, borehole, and river are Na-Cl-SO_4, Na-HCO_3, and Ca-Na-HCO_3-SO_4, respectively. The water quality index (WQI) shows the spring water is not recommended for any domestic purpose but the river water needs treatment for the turbidity and total iron concentrations only. As the finding shows, the spring water is strongly recommended to protect from any consumers.

Keywords: Arsis, water quality, human health, waterborne diseases, spring

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1. INTRODUCTION

The human health effect of contaminated water is disseminated in developing countries all over the world including Ethiopia. Safe water is a prerequisite for health and development. It is a basic human right. Access to safe water drinking and sanitation is a series of issues in the world. However, developing countries have suffered from a lack of access to safe drinking water [1]. As a consequence, people are dependent on unprotected and unsafe water sources such as rivers, lakes, boreholes, hand-dug wells, and springs. Meanwhile, these water sources are open, they are susceptible to flood, and animal and human contaminations. The water quality is affected by an increase in anthropogenic activities and any pollution either physical or chemical causes to changes the quality of the water body[2]. Water-related diseases caused by insufficient safe water supplies coupled with poor sanitation and hygiene [3]. All waterborne, water washed, and water-based and water sanitation associated diseases are related to the quality and quantity of water and sanitation available to customers [4]. World health organizations estimated that up to 80% of the human diseases in the world are from water-borne related diseases [5]. About 1.1 billion people lack access to an improved water source globally. Over three million peoples die annually from water-related diseases. The consequences of poor water quality go beyond health, it is difficult to achieve poverty alleviation, millennium development goals (MDG), and sustainable development goals (SDG) without improvements in water quality. For example, Lack of safe water contributes to intestinal helminth infections [6] and chronic diarrheal disease [7]. These diseases cause malnourished and anemic in children which in turn affects cognitive development [8]. The chemicals in drinking water may also a cause for neurobehavioral test problems, for example, Arsenic and Manganese [9]. About 88% of diarrheal deaths are attributed to unsafe water supply, inadequate sanitation, and poor hygiene [10]. Chemical water contaminations are also strongly affecting human health. The sources of chemical contaminations of drinking water supply are classified into naturally occurring, industrial sources and human dwellings, agricultural activities, water treatment or materials in contact with drinking water, pesticides used in water for public purposes, and Cyanobacterial toxins [3]. For example, the naturally occurring groundwater chemical contaminations are arsenic and fluoride which are a series of potential for human health. Metals (Iron and manganese) and salinity are also chemical contamination in water which able to cause water to be rejected for aesthetic purposes. Drinking water should be suitable for human consumption and for all usual domestic purposes [5]. If the dose amount of the parameters is within the permissible values, the water spring point and the nearby area will be protected from any anthropogenic contaminations to give more service systematically for the community. The great majority of health-related water quality problems are the results of bacteriological or other biological contaminations. Nevertheless, a significant number of very serious problems may occur as a result of the chemical contamination of water resources [5]. Moreover, physical contaminations also affect the water quality for consumers. The surface water is susceptible mainly to biological and physical

contamination when it compares with groundwater which is highly affected by chemical contaminations. Both surfaced water and groundwater are contaminated from natural and anthropogenic sources of contaminants.

In Ethiopia over 60 % of the transmissible diseases are due to poor environmental health conditions arising from unsafe and inadequate water supply and poor hygienic and sanitation practices [11]. About 80 % of the rural and 20 % of the urban population have no access to safe water. Three-fourth of the health problems of children in the country are transmissible diseases arising from the environment, especially water and sanitation. 46% of fewer than 5 years of mortality is due to diarrhea in which water-related diseases occupy a high proportion. The Ministry of Health, Ethiopia estimated 6000 children die each day from diarrhea and dehydration [11]. According to [12], 36% by volume of groundwater in Ethiopia is affected by salinity which is not suitable for any purpose. In addition to this, the Ethiopian main rift valley water resources both groundwater and surface water are characterized by enrichment of fluoride concentration which affects adversely for human health.

The community of the study area, Arsis is used water from boreholes, springs, and seasonal rivers for domestic water supply and livestock purposes. The community of the area serves the spring water for spiritual medicinal value. They believe that the spring water is a medicine for different diseases. The patient people drink the spring water more in amount (e.g. 2 liters at one time) continuously. As a result, the patient affected by diarrhea suddenly. According to personal information, the beneficiary believes that the pains and diseases of the person get away with diarrhea. Moreover, the spring water is campaigned for this purpose but not systematically protected. Therefore, this study is conducted to investigate the water quality of the area for drinking purposes and its implication for human health by measuring both physical and chemical parameters.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study area, Arsis is located in the East-Central Afar Depression. It is found southwestern of Samara which is the capital city of Afar Regional State and at a distance of 40km (Fig 1). The climate condition of the study area is Arid with an annual average temperature of 31.45 ^{o}C and an annual average rainfall of 203 mm. The area is a sandwich with two volcanic rock mountains. These mountains are horst of the graven. The geology of the area consists of alluvial deposits and volcanic rocks mainly basalts and scoriaceous basalts. The horsts are covered with basalt formations whereas the graven is covered with alluvial deposits. The alluvial deposits consist of clay, silt, sand, gravels, and rock fragments. The basalts are stratified and vesicular with gray in color. It is affected by columnar joints, normal faults, and generally highly fractured. The scoriaceous basalts are characterized by dome forming formation with black fresh color, red weathered color, and highly vesicular texture. The orientations of the faults

are NNE-SSW and NNW-SSE (Fig. 2). The lineaments also mainly oriented NE-SW direction.

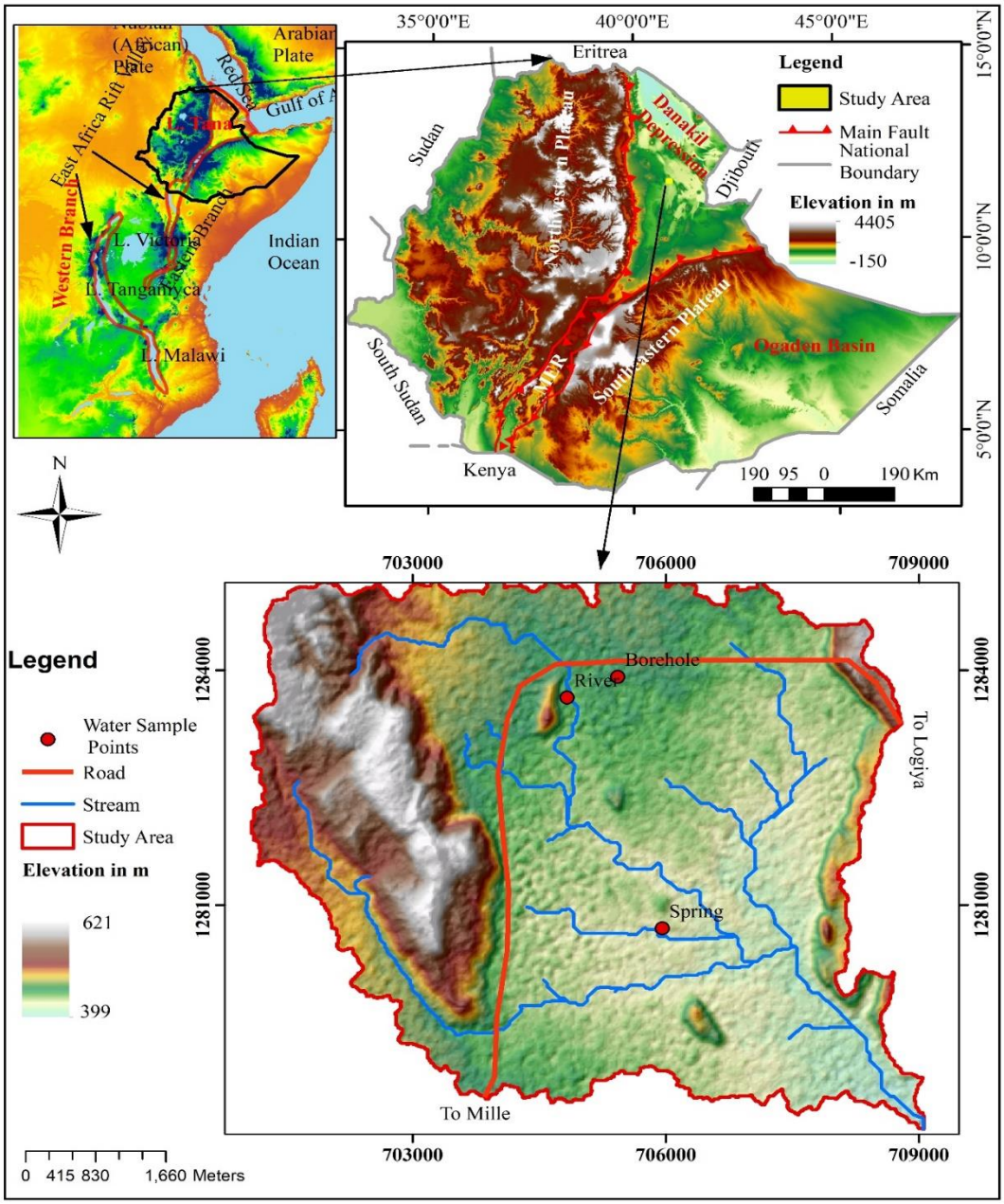


Fig.1. Location map of the study area

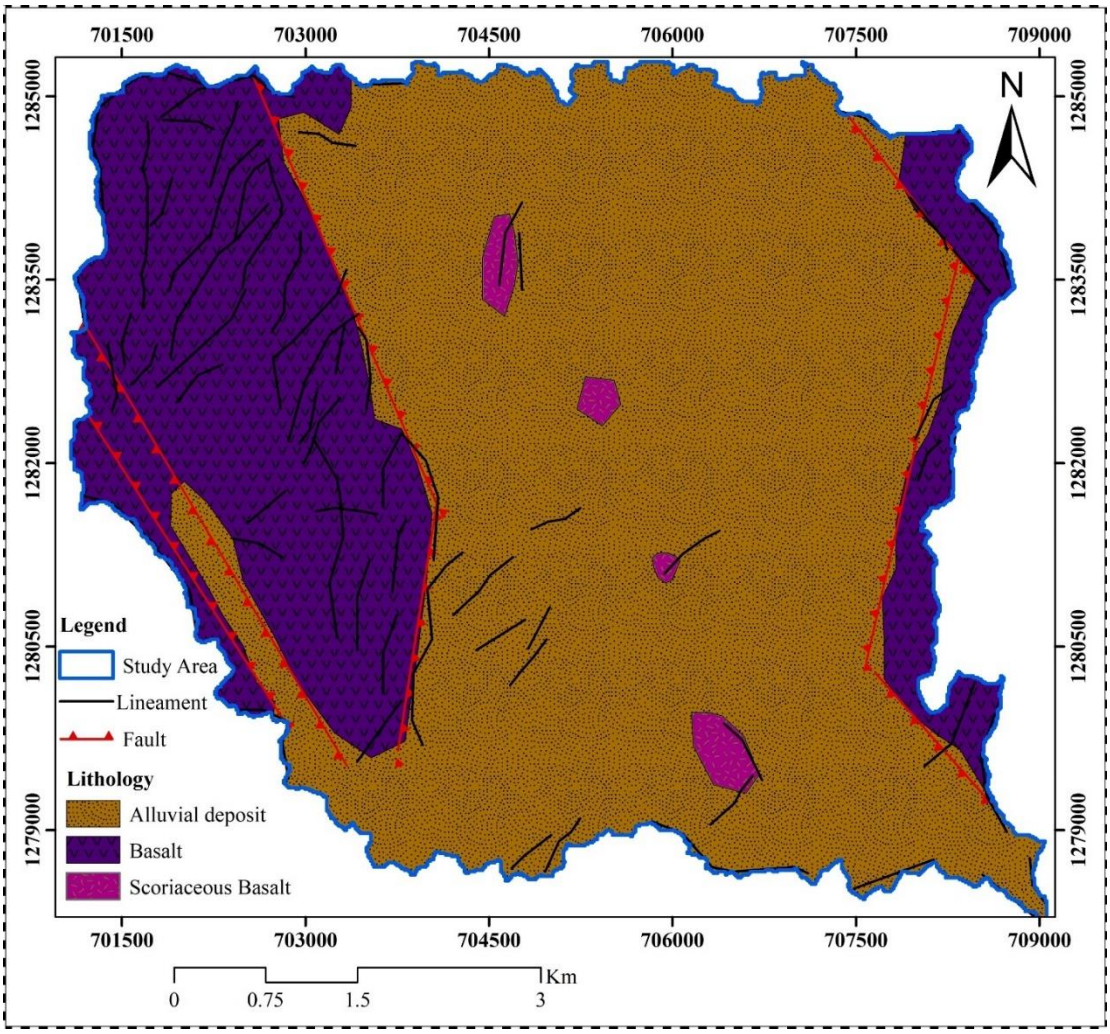


Fig. 2 Geological map

2.2 Methods

A total of three samples were collected from different water points such as borehole, river, and spring (Fig. 3). The water samples are analyzed by Ethiopian Construction Design and Supervision Works Corporation, Water quality laboratory, Addis Ababa. The analyzed parameters are Color, pH, Electrical conductivity (EC), Total solids 105ºC, Total dissolved solids (TDS), Turbidity, Sodium (Na^+) Potassium (K^+), total iron (Fe^{2+} and Fe^{3+}), Manganese (Mn), Ammonia (NH_3-N), total hardness ($CaCO_3$), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Alkalinity ($CaCO_3$), Carbonate (CO_3^{2-}), Bicarbonate (HCO_3^-), Chloride (Cl^-), Sulphate (SO_4^{2-}), Fluoride (F^-), Phosphate (PO_4^{3-} P), Aluminum (Al), Barium (Ba), Copper (Cu), Chromium (Cr^{6+}), Boron (B), Zinc (Zn), Molybdenum (Mo), Nickel (Ni) and Silica (SiO_2). Color is measured using true color as Platinum-Cobalt (Pt-Co) units. pH, Electrical conductivity, and total dissolved solids are conducted using Potentiometric. Turbidity, sulfate, and Barium are tested

using Turbidimeter. Total hardness (as CaCO3), Calcium, magnesium, Alkalinity, Carbonate, and bicarbonate are analyzed using Titrimetric. Sodium and potassium are analyzed using Flame photometric. Total iron and chromium are tested using 1,10-Phenothroline and 1,5-Dephenylcarbonohydrazide, respectively. Aluminum, phosphate, copper, and boron are also conducted using Aluminion, Ascorbic acid-Molybdate blue, Bicinchoninate, and Curcumin, respectively. Manganese is analyzed using Periodate oxidation. Ammonia, chloride, and fluoride tested using Nessler, Mohr Argentometric, and Ion-selective electrode techniques, respectively. Zinc, molybdenum, nickel, and silica are estimated using Zincon, Mercaptoacetic Acid, Heptoxime, and Silicomolybdate methods, respectively. The results are presented and compared with the world health organization's water quality standard guideline for drinking purposes. The laboratory results are checked their accuracy using the cation-anion balances (neutrality) method which determined as the following equation.

$$Balance = \frac{\sum(C-A)}{\sum(C+A)} * 100\% \qquad \text{----Equ.1}$$

Sum of cation and anions are in meq/l and expressed in percent; the acceptable range is from -5% to 5%. The results are presented and interpreted using Aquachem4.0 software.

Besides this, the water quality index of the water points is estimated using the standards of drinking water quality recommended by the world health organization [13] as the following procedures. First, the quality rating is calculated using the following equation.

$$q_n = [V_n - V_{io}]/[S_n - V_{io}] \qquad \text{----Equ.2}$$

q_n = quality rating for the nth water quality parameter, V_n = estimated value of the nth parameter at a given sampling point, V_{io} = ideal value of the nth parameter in pure water (i.e. 0 for all parameters except for pH (7) and dissolved oxygen (14.6 mg/l)), and Sn is standard permissible value.

Unit weight is calculated using the following expression.

$$W_n = K/S_n \qquad \text{----Equ.3}$$

W_n = unit weight is a value inversely proportional to the recommended standard. K is constantly proportion (1) and S_n is recommended standard value.

Finally, the water quality index of the sample is determined using the next formula.

$$WQI = \sum q_n W_n / \sum W_n \qquad \text{----Equ.4}$$

WQI = the overall water quality index of the water sample.



Fig. 3 Water samples from (A) borehole, (B) River and (C) Spring

3. RESULTS AND DISCUSSION

3.1 Color and Turbidity

Color in drinking water is due to the presence of organic matter, industrial wastes, and chemicals. So, drinking water should be ideally colorless. The spring water is observed with a yellowish color because of physical contaminations in the area. The color of the river and spring are beyond the recommended standard by the US which is 15 Pt-Co but the borehole is within the standard value. The turbidity of the water is affected due to the presence of suspended matters. Both the spring and river water samples are exceeded 5 NTU which is the maximum permissible level for consumers.

3.2 pH and Electrical Conductivity

pH is a measure of acidity or alkalinity of the water and provides vital information in any type of geochemical equilibrium or solubility calculation in water [14]. According to [15], the permissible pH value ranges from 6.5 to 8.5. The pH value of water samples from the area is 7.74 in the river, 7.81 in the spring, and 7.94 in the borehole waters. This result indicates the groundwater and river water sources are slightly basic in nature

due to the weathering nature of basalt. All water samples are within the permissible range for drinking use. The EC value of the borehole, river, and springs is 956, 230, and 44,200µS/cm, respectively. Freshwaters are an insulator rather than the conductor of electric current. It is the property of water with the ability to conduct an electric current and a function of dissolved solids. High ions in water can have high electrical conductivity. The desirable limit of EC for drinking purposes is 1,000 µmhos/cm [1]. The spring water is observed with very high electrical conductivity enrichment which indicates the salt enrichment is very high. Except for the spring water, all samples are permissible for drinking water supply.

3.3 Total dissolved solids

The total dissolved substance of the borehole, river, and spring is 327, 110, and 24,800mg/l, respectively. TDS is a measure of the total amount of dissolved minerals in the water. Based on who1984, waters can be classified into four in terms of TDS value such as Excellent (TDS < 300), Good (300-600), Fail (600-900), poor (900-1200) and unacceptable (TDS > 1200 mg/l). According to this classification, the river water is laying in excellent, the borehole is within a good, and spring water is in the unacceptable water type. As a result, the spring water is not permissible for drinking purposes because it exceeds the maximum allowable level which is 1000 mg/l [16]. However, Since a TDS value exceeds 500 mg/l result in excessive scaling in water pipes, water heaters, boilers, and household appliances such as kettles and steam irons [17] According to the [18] discussion, the high value of TDS in groundwater are not harmful to human being but it affects for who suffering by kidney and heart disease. Moreover, high solid in water may cause laxative and constipation effects [19].

3.4 Total Hardness

Water hardness is a measure of the relative abundance of bivalent cations [20]. Calcium and magnesium are the principal cations that can cause water hardness. Total hardness is estimated as:

$$\text{Hardness} = 2.5(Ca^{2+}) + 4.1(Mg^{2+}) \quad (5)$$

Where Ca^{2+} and Mg^{2+} are concentrations in mg/l.

[21] have classified water based on total hardness into soft (TH < 75), moderately hard (75-150), hard (150-300), and very hard (TH> 300 mg/l of $CaCO_3$. Accordingly, the borehole and river samples are soft waters while the spring water sample is very high and not permissible for domestic water supply. Drinking waters should not be hard. However, health studies in several countries in recent years indicate that mortality rates from heart diseases are lower in areas with hard water [22].

3.5 Cations (Calcium, Magnesium, Sodium, and Potassium)

3.5.1 Calcium

The calcium concentration is 22 mg/l in the river, 14.08 mg/l in the borehole, and 589 mg/l in the spring waters. Calcium is the most important and abundant in the human body and stored in bones and teethes [22]. An adequate intake of calcium is very

essential for growth and health. Shortage of calcium in humans may cause rickets, poor blood clotting, bone fracture while an excess of calcium develops cardiovascular diseases. According to [23], the maximum limit in drinking water is 75 mg/l. Accordingly, the spring water is not permissible water for drinking in the study area.

3.5.2 Magnesium

The river, borehole, and spring waters have a magnesium concentration of 2.64, 8.45, and 266.64 mg/l, respectively. It is also one of the most abundant and major dietary requirements for humans (0.3-0.5 g/day) [22], very essential for function living organisms and the human body contains 25 grams in muscles and tissues. Magnesium is very important when combining with sulfate and use medically as "Epsom salt" a laxative. Geologically, it found mainly in dolomite and magnetite minerals. According to the WHO standards, the permissible range of magnesium in drinking water is 50 mg/l. As a result of this study, the magnesium concentration of the spring water is not permissible for drinking water whereas the rivers and boreholes are with the allowable limit.

3.5.3 Sodium

The sodium concentration of the river is 8.6 mg/l, of the borehole is 162 mg/l and of the spring is 9750 mg/l. The common sources of sodium in groundwater are the erosion of salt deposits, weathering of sodium bearing rocks, brackish aquifers, and intrusion of seawater to aquifers. It is a very essential parameter for human food when it combines with chloride as sodium chloride. Excess of sodium in water is not recommendable for human health especially when it associates with sulfate [22]. High sodium concentration causes kidney damage, hypertension, and headache but it protects from these fatal diseases when the proper amount of sodium use. According to [24], the maximum allowable sodium concentration in drinking water is 200 mg/l. Hence, the spring water in the study area has a huge amount of sodium concentration which unable to consume for domestic water supply. It causes also for the groundwater to be unpleasant salty taste [3].

3.5.4 Potassium

The potassium concentration value of the river, borehole, and spring are 2.8, 5.4, and 16.40 mg/l, respectively. Naturally, potassium is occurring in silicate minerals like orthoclase, microcline, hornblende, muscovite, and biotite in igneous and metamorphic rocks and evaporate deposits gypsum and sulfate [25]. Potassium is very important for human and it is a concern for health in excess amount in water. The importance of potassium as potassium chloride and potassium permanganate is to treat saline water to remove sodium chloride from water. The high dose of drinking water cause kidney dysfunction, heart disease, coronary artery disease, hypertension, diabetes, adrenal insufficiency and pre-existing hyperkalemia [13]. According to the WHO standard, the permissible limit of potassium in drinking water is 12 mg/l. The spring water is not fit for domestic purposes in the study area. As a consequence, this may cause the heath of the consumers in the area.

3.6 Anions (Chloride, Fluoride, sulfate, carbonate, and bicarbonate, Phosphate and Ammonia)

3.6.1 Chloride

The chloride concentration in the river, borehole, and spring waters are 2.19, 61.23, and 952.88 mg/l, respectively. Chloride is obtained from the dissolution of salts in the form of sodium chloride and added from industrial influents sewage and seawater intrusions. Groundwater is a high concentration of chloride as compared to surface water and confirmed in the study area. Excess concentration of chloride in water able to damage pipelines and structures and very harmful for growing plants [18]. The maximum permissible limit of chloride concentration in drinking water is 250 mg/l. The chloride concentration of the spring water is too huge and not meet the world health organization standard.

3.6.2 Fluoride

The concentration of fluoride in the river, borehole, and spring water of the study area are 0.17, 1.4, and 1.6 mg/l. Fluoride naturally occurs in rocks in many geological environments [14]. Fluoride concentration is very high in groundwater that associated with acidic volcanic rock. Ethiopia is one of the countries affected by a high concentration of fluoride in groundwater [1]. The fluoride concentration in drinking water is very important for bones and teeth at normal intake or low concentration. However, in excess amounts, it is toxic to human health. The adverse effect of fluoride concentration in water for human health depends on the amount of fluoride. The maximum permissible limit of fluoride concentration in drinking water is 1.5 mg/l [24]. The fluoride concentration below 1.5 mg/l is very important for teeth health, from 1.5 to 3 mg/l cause dental fluorosis (mottling of teeth), from 4 to 10 mg/l which cause dental and skeleton fluorosis (pain in back and neck bones) and much higher than 10mg/l able to cause crippling fluorosis [26]–[28]. As a result of fluoride concentration in the area, the spring water is slightly affected which can cause dental fluorosis (mottling of teeth) for the consumers. However, the borehole and river waters are meet the world health organization standard.

3.6.3 Sulfate

The sulfate concentration in the river, borehole, and spring waters in the study area are 25.72, 85.80, and 12.039.48 mg/l, respectively. The sulfate concentration in spring water is much higher than the other water resources in the area. Sulfateoccurs naturally from the dissolution of sulfate-rich minerals like pyrite and discharge from industrials. The high concentration of sulfate has a laxative effect especially when it combines with magnesium and sodium. The permissible value of sulfate concentration in drinking water is established as 250mg/l [15]. The spring water in the study area has an unacceptable concentration of sulfate for domestic purposes whereas the borehole and river waters are falls within the permissible value.

3.6.4 Carbonate and bicarbonate

The carbonate concentration values of the river, borehole, and spring waters in the study area are nil. The concentration of bicarbonate of the river, borehole, and springs waters in the study area are 73.20, 366, and 280 mg/l. The surface water has low bicarbonate as compare with groundwater in the study area. The high concentration of bicarbonate has no adverse human health effect unless it combined with a large amount

of calcium and magnesium which cause carbonate hardness, affect the taste and corrosiveness of water.

3.6.5 Phosphate and ammonia

The concentration values of phosphate in the river, borehole, and spring water of the area are 0.13, 0.36, and 0.06 mg/l. The concentration of ammonia also reported as 0.34 in the river, 0.03 in the borehole, and 0.07 mg/l in the spring water of the study area. These concentrations are very low in the area and do not have any human health impact for the consumers in the study area.

3.7 Heavy Metals

The concentration values of heavy metals such as Aluminum, copper, chromium, lead, zinc, molybdenum, barium, boron, nickel, iron, and silica are a trace in the water samples from the study area. Except for boron in the spring water found with 2.2 mg/l which exceeds the maximum allowable level in drinking water that is 0.3 mg/l [29]. But the other heavy metals have no significant impact on human health.

3.8 Water types and hydrochemistry facies

The water types of the springs, borehole, and river are Na-Cl-SO_4, Na-HCO_3, and Ca-Na-HCO_3-SO_4, respectively (Fig. 4). This indicates that the groundwaters are highly dominated by sodium concentration from cations whereas surface water is by calcium. The source of the waters found in the area is not from the same. The piper diagram shows the spring water is alkalis exceed alkaline earth and strong acids exceed weak acids. The spring water is characterized by non-carbonate alkalinity (primary salinity) exceeds 50% and chemical properties are dominated by alkalis and strong acids. This spring water is fitted in the area of ocean waters and many brines plot near the right-hand vertex of the piper diagram (Fig. 4).

The river water is characterized by alkaline earth exceed alkalis, weak acids exceeds strong acids and carbonate hardness exceeds 50%. The chemical of borehole water has a property of alkalis exceed alkaline earth, weak acids exceed strong acids and no one pair cation-anion exceeds 50% (Fig. 4).

3.9 Water quality index

The water quality index affords a single number that defines a total water quality of the samples at a certain location and time, based on several water quality parameters. The water quality index, river, and borehole water bodies are determined. The results are 366.07 in spring water (Table 1), 166.86 in river water (Table 2), and 32.92 in the borehole water body (Table 3). Chaterjee and Raziuddin (2002) classified water quality status based on the water quality index level as 0 – 25 (excellent water quality), 26-50 (good water quality), 51-75 (poor water quality), 76-100 (very poor water quality) and greater than 100 (unsuitable for drinking) [30]. Based on this classification the river and spring waters are categorized in the unsuitable for drinking purposes. Theses water bodies are needed for further treatment. The spring water is unsuitable for drinking purposes because of all parameters except pH, total iron, and phosphate. The river water becomes unsuitable for drinking purposes because of turbidity and total iron only. The river water sample result indicates that it carries suspended substances and

passes through iron-rich geological material. The water from the borehole is grouped in the good water quality for drinking purposes.

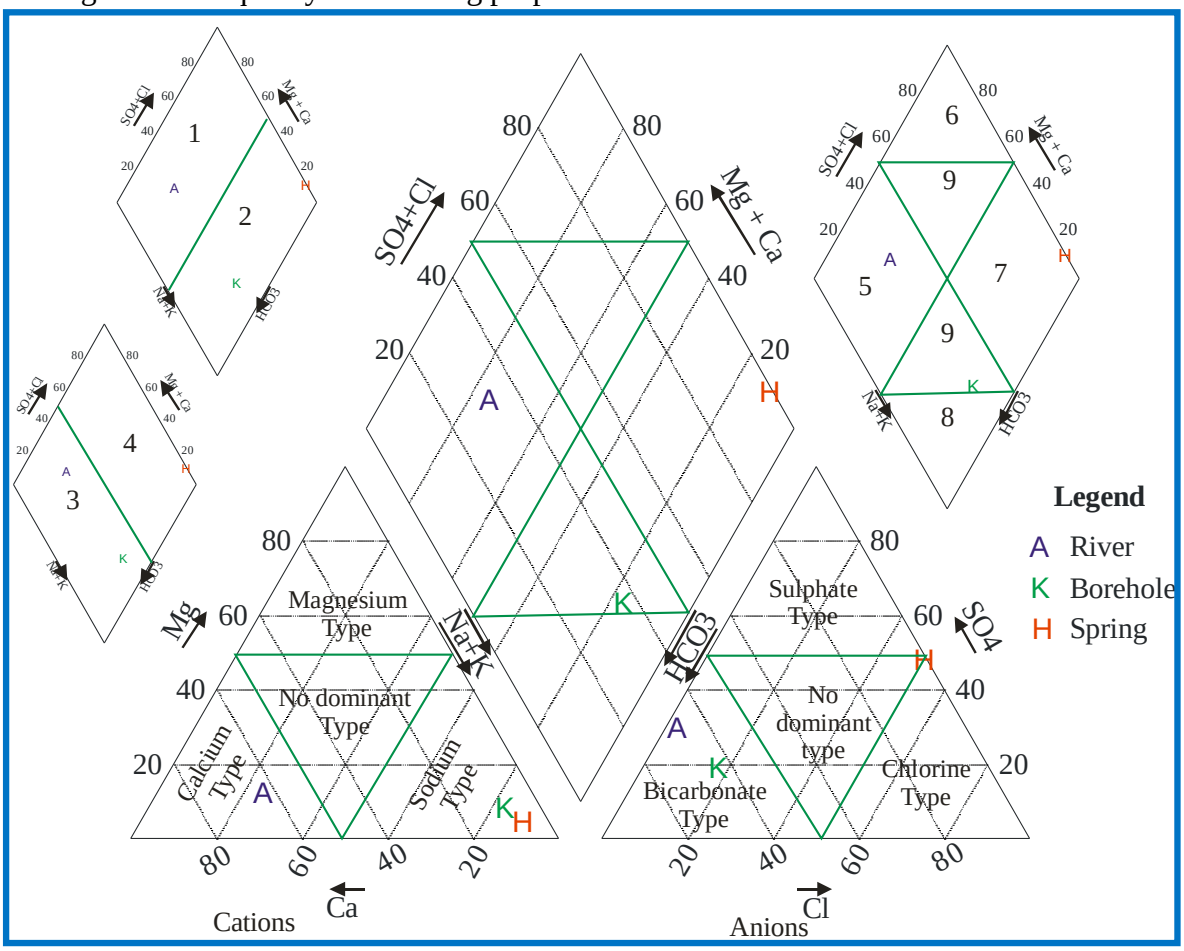


Fig. 4 Piper diagram

Table 1. Water quality index of the spring water in Arsis area

No	Parameters	V_n	S_n	W_n	q_n	W_nq_n
1	pH	7.81	8.5	0.12	54.00	6.35
2	EC	44200	1000	0.00	4420.00	4.42
3	TDS	24800	500	0.00	4960.00	9.92
4	TU	29	5	0.20	580.00	116.00
5	Na^+	9750	200	0.01	4875.00	24.38
6	K^+	16.4	12	0.08	136.67	11.39
7	Fe	0.13	0.3	3.33	43.33	144.44
8	TH	2585	500	0.00	517.00	1.03

9	Ca^{2+}	589	75	0.01	785.33	10.47
10	Mg^{2+}	266.64	50	0.02	533.28	10.67
11	TA	230	120	0.01	191.67	1.60
12	HCO_3-	280.6	120	0.01	233.83	1.95
13	Cl^-	9562.88	250	0.00	3825.15	15.30
14	SO_4^{2-}	12039.48	250	0.00	4815.79	19.26
15	F^-	1.6	1.5	0.67	106.67	71.11
16	PO_4^{3-}-P	0.06	10	0.10	0.60	0.06
17	B	2.2	0.3	3.33	733.33	2444.44
$WQI = \sum Wnqn / \sum Wn = 366.07$				$\sum Wn = 7.90$		$\sum Wnqn$ =2892.80

Table 2. Water quality index of river water in Arsis area

No	Parameters	V_n	S_n	W_n	q_n	W_nq_n
1	pH	7.74	8.5	0.12	49.33	5.80
2	EC	230	1000	0.00	23.00	0.02
3	TDS	110	500	0.00	22.00	0.04
4	TU	79	5	0.20	1580.00	316.00
5	Na^+	8.6	200	0.01	4.30	0.02
6	K^+	2.8	12	0.08	23.33	1.94
7	Fe	0.37	0.3	3.33	123.33	411.11
8	TH	66	500	0.00	13.20	0.03
9	Ca^{2+}	22	75	0.01	29.33	0.39
10	Mg^{2+}	2.64	50	0.02	5.28	0.11
11	TA	60	120	0.01	50.00	0.42
12	HCO_3-	73.2	120	0.01	61.00	0.51
13	Cl^-	2.19	250	0.00	0.88	0.00
14	SO_4^{2-}	25.7	250	0.00	10.29	0.04
15	F^-	0.17	1.5	0.67	11.33	7.56
16	PO_4^{3-}-P	0.13	10	0.10	1.30	0.13
$WQI = \frac{\sum Wnqn}{\sum Wn} = 162.86$				$\sum Wn$ =4.57		$\sum Wnqn = 744.13$

Table 3. Water quality index of borehole water in Arsis area

No	Parameters	V_n	S_n	W_n	q_n	W_nq_n
1	pH	7.94	8.5	0.12	62.67	7.37
2	EC	956	1000	0.00	95.60	0.10
3	TDS	327	500	0.00	65.40	0.13
4	TU	1	5	0.20	20.00	4.00
5	Na^+	162	200	0.01	81.00	0.41
6	K^+	5.4	12	0.08	45.00	3.75
7	Fe	0.06	0.3	3.33	20.00	66.67
8	TH	70.4	500	0.00	14.08	0.03
9	Ca^{2+}	14.08	75	0.01	18.77	0.25
10	Mg^{2+}	8.45	50	0.02	16.90	0.34
11	TA	300	120	0.01	250.00	2.08
12	HCO_3-	366	120	0.01	305.00	2.54
13	Cl^-	61.23	250	0.00	24.49	0.10
14	SO_4^{2-}	85.8	250	0.00	34.32	0.14
15	F^-	1.4	1.5	0.67	93.33	62.22
16	PO_4^{3-}-P	0.3	10	0.10	3.00	0.30
$WQI = \frac{\sum Wnqn}{\sum Wn} = 32.92$				$\sum Wn = 4.57$		$\sum Wnqn = 150.42$

4. CONCLUSION AND RECOMMENDATION

The river and borehole waters are freshwaters as compare with the spring water. The water quality of the spring is highly affected by naturally occurring contaminates. Except for the trace elements, all parameters in the water spring have adversely affected human health and exceeds the world health organization standards. The spring water contains substances that can distress who suffering from kidney and heart diseases, cause laxative and constipation effects, cardiovascular disease, kidney damage and disinfection, hypertension, headache, coronary artery disease, diabetes, adrenal insufficient, and hyperkalemia. The hydrochemistry facies of the water points indicates the water sources are from different aquifer nature. The borehole water is recharged from shallow aquifer whereas the spring is obtained from a deep. The movement of the spring water is due to geological structures control. The water quality index of the spring water indicates that to not consume for domestic water supply for long terms.

The river water needs some treatment mechanism to remove the turbidity and total irons. The borehole water is potable water and suitable for any purpose.

5. REFERENCES

1. WHO, "Guidelines for Drinking-water Quality FIRST ADDENDUM TO THIRD EDITION Volume 1 Recommendations," *World Health*, 2006.
2. M. Aremu, O. Olaofe, P. Ikokoh, and M. Yakubu, "Physicochemical characteristics of stream, well and borehole water sources in Eggon, Nasarawa State, Nigeria," *J Chem Soc Niger.*, 2011.
3. UNESCO, "UNESCO Handbook on Water Quality," 2008.
4. L. S. Abebe, "Hygiene water quality: its relation to health and the testing aspects in tropical conditions.," *Dep. Civ. Eng. Univ. Tempere, Finl.*, 1986.
5. WHO, "Guidelines for drinking-water quality," *WHO Chron.*, vol. 38, pp. 104–108, 1997.
6. L. S. STEPHENSON, M. C. LATHAM, and E. A. OTTESEN, "Malnutrition and parasitic helminth infections," *Parasitology*, 2000.
7. E. Pollitt, "The Relationship Between Undernutrition and Behavioral Development in Children.," *United Nations Univ.*, 1995.
8. R. Dillingham and R. L. Guerrant, "Childhood stunting: Measuring and stemming the staggering costs of inadequate water and sanitation," *Lancet.* 2004.
9. G. A. Wasserman *et al.*, "Water arsenic exposure and children's intellectual function in Araihazar, Bangladesh," *Environ. Health Perspect.*, 2004.
10. WHO, "The World Health Report 2005: Make every mother and child count The World Health Report 2005," *World Heal. Rep.*, 2005.
11. MOH, "Knowledge, attitude and practice of water supply, environmental sanitation and hygiene practice in selected worked as of Ethiopia," Addis Ababa, 2011.
12. S. Kebede, *Groundwater in Ethiopia: Features, numbers and opportunities*. 2013.
13. WHO, "Guidelines for drinking-water quality - 4° ed. Geneva.," *Who*, 2011.
14. J. D. Hem, "Study and interpretation of the chemical characteristics of natural water.," *US Geol. Surv. Water-Supply Pap.*, 1985.
15. WHO, "Guidelines for Drinking-water Quality. Third Edition. Volume 1. Recommendations," *Who*, 2004.
16. WHO, "Water, Sanitation and Hygiene - Links to Health. Facts and Figures updated November 2004," *World Health*, 2004.
17. D. P. Tihansky, "Economic damages from residential use of mineralized water supply," *Water Resour. Res.*, 1974.
18. Y. Meride and B. Ayenew, "Drinking water quality assessment and its effects on residents health in Wondo genet campus, Ethiopia," *Environ. Syst. Res.*, vol. 5, no. 1, pp. 1–7, 2016.
19. S. Sasikaran, K. Sritharan, S. Balakumar, and V. Arasaratnam, "Physical, chemical and microbial analysis of bottled drinking water.," *Ceylon Med. J.*, 2012.
20. R. F. Charles, *Groundwater Science*. London: UK: Academic Press, An imprint of Elsevier Science, 2002.
21. C. Sawyer and P. McCarty, *Chemistry for sanitary engineers*, 2nd ed. New York: McGraw–Hill, 1967.
22. EPA, "Parameters of water quality Interpretation and Standards," 2001.

23. WHO, *Guidelines for Drinking-water Quality 4th ed., WHO, Geneva, p. 340.* 2011.
24. WHO, "GUIDELINES FOR DRINKING-WATER QUALITY. Vol.1. Reccomendation," Geneva, 1984.
25. J. A. Sayyed and A. B. Bhosle, "Analysis of Chloride , Sodium and Potassium in Groundwater Samples of Nanded City in Mahabharata , India," *Eur. J. Exp. Biol.*, vol. 1, no. 1, 2011.
26. B. B. S. Singhal and R. P. Gupta, *Applied hydrogeology of fractured rocks: Second edition*. 2010.
27. C. B. Dissanayake, "The fluoride problem in the groundwater of sri lanka-environmental management and health," *Int. J. Environ. Stud.*, 1991.
28. H. Gebru and J. Ahmed, "Water quality assessments as implication to human health: A case study in awash sebat and its surrounding areas, Afar, Ethiopia," *Int. J. Earth Sci. Eng.*, 2016.
29. WHO, "Guidelines for Drinking-water Quality THIRD EDITION INCORPORATING THE FIRST AND SECOND ADDENDA Volume 1 Recommendations Geneva 2008 WHO Library Cataloguing-in-Publication Data," *Guidel. Drink. Qual.*, 2008.
30. C. Chaterjee and M. Raziuddin, "Detrmination of water quality index (WQI) of a degraded river in Asanol industrial area, Raniganj, Burdwan, West Benga.," *Nat. Environ. Pollut. Technol.*, vol. 1, no. 2, pp. 181–189, 2002.

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FACTORS THAT INFLUENCING TAXPAYERS' COMPLIANCE BEHAVIOR CATEGORY "C" TAXPAYERS IN EASTERN ZONE OF TIGRAY, ETHIOPIA

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ABSTRACT

The study was focused on the investigation of the factors that influencing taxpayer's compliance behavior in Eastern Zone of Tigray in Category "C" taxpayers. In order to gain an in depth understanding of the phenomenon, the study expands the basic tax payers' compliance variable to incorporate tax service quality, tax system/structure, attitude towards tax evasion, type of occupation, income level and financial condition. In order to achieve the desired objectives of the study, primary data were collected through self-administered questionnaires from 380 sampled respondents, which is a cross sectional type. The collected data were treated and analyzed statistically using ordered logistic regressions analysis with the help of STATA version 11. Moreover, descriptive statistics was also used for both questionnaire and interview via content analysis. The findings of the study revealed that the descriptive statistics on the surveyed sample perceived the tax service quality and tax system structure were ineffective and business profit taxpayers shown unfavorable attitude towards tax evasion based up on the interview as well. The findings also indicated that, based on ordered logistic regression, all variables found to have a positive effect on tax payers' compliance behavior. Particularly tax service quality, occupation and financial condition significantly affect the tax payers 'compliance behavior at 95 % confidence interval.

Keywords: financial condition, tax compliance, tax service quality, occupation and taxpayer's level income.

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1. INTRODUCTION

The significance of the equality principle in tax is quite critical; the Ethiopian government has continuously given attention to the issues of tax policy of the country pursuant to the structural changes. For instance, the tax authority has reduced the top employment income tax rate and business marginal income tax rate for encouraging individuals to work more and to address the issue of vertical equity and dividend tax rate reduced to encourage private sectors to participate in share companies. Moreover, this helps in reducing the burden of tax to feel confer while taxpayers are paying their obligation to be committed to pay within the stated time and amount.

A number of factors may determine the tax compliance behavior negatively or positively so understanding these factors with related to taxpayers particularly; for example the cultural background of tax payers, their awareness level, compliance behavior and its determinants when designing a given tax system. Likewise, determinants of tax compliance especially financial constraints of taxpayers are not taking into account for their compliance behavior (Eckstein, 1979).

During the five year Ethiopia Growth and transformation plan (GTP) two period, domestic revenue (tax and non-tax revenue), including grant , is expected to reach ETB 310 bln by the end of the plan period, out of this, ETB 261.636 bln will be mobilized from tax revenue that is including all Ethiopian regions. In order to achieve the GTP two, it is necessary to take a in to consideration the study on the factors influencing taxpayer's compliance behavior in Eastern Zone of Tigray for those business profit taxpayers particularly category "C" who are not classified under the other two categories ("A" and "B"), which has an annual turnover is estimated by the Tax Authority as being up to Birr 100,000 (One hundred thousand Birr) (Ministry of Finance and Economic Development Ethiopia Nov., 2010).

To the best knowledge of the investigators, there is no research conducted on the factors that influencing taxpayer's compliance behavior so far in Eastern Zone of Tigray business income taxpayer's category 'C" and other related types of taxes. And the investigators observe, some of taxpayers are not eager to pay their obligations at specified time with stated amounts by the authority, so that this study hopes to answer the deemed perceptions of taxpayers.

The main objective of this study is to investigate the factors that influencing taxpayer's compliance behavior in Eastern Zone of Tigray Category "C" taxpayers.

The specific objectives of this study are follows:

i. To assess tax system structures with taxpayer's compliance behavior.
ii. To find out attitudes toward tax evasion with taxpayer's compliance behavior.
iii. To examine taxpayer's income level that effect on taxpayer's compliance behavior.
iv. To ascertain the influence of financial condition on taxpayer's compliance behavior.

v. To assess taxpayer's type of business occupation that has an effect on taxpayer's compliance behavior.
vi. To assess the effect of tax service quality on taxpayer's compliance behavior.

2. MATERIALS AND METHODS

2.1 Research Design

In order to achieve the objectives of the study, a descriptive research design with qualitative and quantitative approaches were used.

2.2 Data Sources, Type and Collection Methods

The study used both primary and secondary sources so as to obtain the primary and secondary data types respectively. Structured questionnaires and semi-structured interviews were used to collect the primary data from category "C" taxpayers' of each sampled woredas.

2.3 Sampling Design and Sample Size Determination

There are nine (09) towns in the eastern zone of the regional state of Tigray. In selecting towns to be included in this study, purposive sampling design was used. Towns had to have 1,000 or above registered category 'C' tax payers as of the end of year 2007 E.C. Hence, four (04) towns, namely, Adigrat, Wukro, Freweyni and Atsbi wenberta were selected and included in the study.

Moreover, as per the information obtained from National Regional State of Tigray Revenue Development Authority, there were 13,213 individual business profit category 'C' taxpayers in Eastern Zone of Tigray , from this 8,391 in Adigrat, Wukro, Freweyni and Atsbi wenberta towns as of the year 2007 E.C.

Thus, the sample size was determined according to the formula given by Yamane's (1967:886) as follows:

$$n = \frac{N}{1+N\,(e)\,2} \qquad \text{----Equ.1}$$

$$n = \frac{8{,}391}{1+8{,}391\,(0.05)\,2}$$

$$= \mathbf{380}$$

Where, 'N' indicates the population size, 'n' indicates the sample size and 'e' indicates the margin of error. In this study, a 5% margin of error was used. Accordingly, the sample size was determined to be approximately 380 shown in Table 1.

Table 1. Determination of sample size

Town	Population	Sample size
Adigrat	3,873	175
Wukro	1,848	84
Freweyni	1,500	68
Atsbi Wenberta	1,170	54
Total	**8,391**	**380**

2.4 Methods of Data Analysis and presentation

Ordered logistic regression models were run so as to test the hypotheses on the relationships between and among variables. In running the ordered logistic regression models, STAT SE 11 software was employed.

2.5 Research Hypotheses

H_O1: Tax payers' financial condition has no significant effect on tax compliance behavior.
$H_1$1: Tax payers' financial condition has significant effect on tax compliance behavior.
$H_0$2: Tax system/structure has no significant effect on tax compliance behavior.
$H_1$2: Tax system/structure has significant effect on tax compliance behavior.
$H_0$3: Tax payers' attitude has no significant effect on tax compliance behavior.
$H_1$3: Tax payers' attitude has significant effect on tax compliance behavior.
$H_0$4: Tax payers' income level has no significant effect on tax compliance behavior.
$H_1$4: Tax payers' income level has significant effect on tax compliance behavior.
$H_0$5: Tax payers' occupation type has no significant effect on tax compliance behavior.
$H_1$5: Tax payers' occupation type has significant effect on tax compliance behavior.
$H_0$6: Tax service quality has no significant effect on tax compliance behavior.
$H_1$6: Tax service quality has significant effect on tax compliance behavior.

2.6 Model Specification

To examine the factors that influencing tax payers' compliance behavior, the researchers had formulated the following general model:

$$Y_i = \beta_0 + \Sigma \beta_i X_i + \varepsilon_i$$

----Equ.2

Where: Yi are the ith observation of dependent variable (TC)
β0 is the intercept of the equation
βi are coefficients of Xi variables
Xi are the different independent variables
εi is the error term

Specifically, when the above general model is converted into the specified Variables of this study the following regression equations were run to measure the factors that influencing tax payers' compliance behavior.

$$TC\ i = \beta 0 + \beta 1(FC\ i) + \beta 2(TS\ i) + \beta 3(ATTE\ i) + \beta 4(IL\ i) + \beta 5(TO\ i) + \beta 6(TSQ\ i) + \varepsilon$$

----Equ.3

Where:
TC i = Tax compliance of observation i
FC i = Tax payers' financial condition of observation i
TS i = Tax system/structure of observation i
IL= Tax payers' income level of observation i
TO = Tax payers' type of occupation of observation i
TSQ= Tax service Quality of observation i

3. RESULTS AND DISCUSSION

3.1 Econometrics Analysis and Discussions

In addition to the descriptive analysis, this section of the study presents the results and discussions of the regression /econometrics analysis. So far the study had established a framework of literature and data analysis including descriptive statistics in order to investigate the factors that influencing tax payers' compliance behavior. In order to shed more light on the factors that influencing tax payers' compliance behavior, multiple regression models have been run, such as p-value, R-squares (R^2), adjusted R-square, significance test, beta coefficients using State version 11. In this study, the conceptual framework discussed in the earlier chapter guided the selection of the explanatory variables. The explanatory variables include in the first model i.e. main effect of tax service quality, attitude towards tax evasion, tax system structure, types of occupation, financial condition and noncompliance opportunities.

Thus, the data collected from 352-business profit taxpayers in category C taxpayers in Easter Zone of Tigray had been examined using a multiple regressions, simply a multiple regression which includes interaction terms as well as main effects. It fits tests, the estimates and tests of the interaction term are unaffected. There are three types of multiple regressions; each of them has motives to answer a different question: Standard multiple regressions utilize to evaluate the relationships between a set of independent variables and a dependent variable. Hierarchical regression employ to examine the relationships between a set of independent variables and a dependent variable, after controlling for the effects of some other independent variables on the dependent variable. In addition, Stepwise, or statistical, regression is used to identify the subset of independent variables that has the strongest relationship to a dependent variable. On this study, the researchers used hierarchical multiple regression since the purpose is to investigate the factors that influence tax compliance behavior in Easter Zone of Tigray.

The researchers used ordered Logistic regression analysis specifically; to analyze the relationship between dependent and independent variables. Since the dependent variable is Dummy, the appropriate econometric model for such variables is ordered Logistic regression model. The primary objectives in regression analysis are to find out how the average value of the dependent variable (or regressed) varies with the given value of the explanatory variable (or repressor). Before the regression analysis carried out, the assumptions of Spearman correlation matrix and in order to reduce the effect of multicollinearity, the variables has centered as suggested by Aiken and West (1991) as cited by Haile H.

To make the data ready for analysis and to get reliable output from the research different tests were run. In this study as mentioned in chapter three diagnostic tests were carried out to ensure that the data fits the basic assumptions of classical linear regression model. , i.e. the OLS assumptions, are fulfilled when the explanatory variables are regressed against the dependent variables.

Test results for the linear regression model assumptions applied properly. The Pearson correlation matrix shows that the correlation between and among each independent and dependent variable is not strong, suggesting multi-colinearity problems are either not severe or non-existent. Since as a general rule of thumb multi-collinearity is a problem when the correlation result is above 0.80 and below -0.80, but in this case, it is under 0.3229 and over -0.2545 as it can be seen in Table 2.

Variance inflating factor (VIF) was used to check for multi-colinearity problem among and between variables. VIF result shows that there is no perfect collinearity among and between variables because the VIF value is below 2.11, multi-collinearity can be a problem if and only if VIF value exceeds 10 as it can be seen below. The hettest was used to check whether there is hetroscedasticity problem or not and the ovtest was carried out to check whether there is any mistreated non-linearity in the data or not. As a result, the robust regression used to avoid the aforementioned problem in the data. The various goodness-of-fit measures validate that the model fits the data well. All are available also at the Appendix part.

Table 2. Shows that result of: ***Spearman, vif, Ramesy RESET test and Hereroskedasticity***

```
. *(7 variables, 352 observations pasted into data editor)

. spearman tcomp occupation income financial_condn tax_system attitude tax_servicequality
(obs=352)
```

	tcomp	occupa~n	income	financ~n	tax_sy~m	attitude	tax_se~y
tcomp	1.0000						
occupation	0.0768	1.0000					
income	0.0934	-0.0438	1.0000				
financial_~n	0.1143	-0.0213	0.2950	1.0000			
tax_system	0.0960	-0.0659	-0.2792	-0.0579	1.0000		
attitude	-0.0075	0.0155	-0.0277	0.1424	0.2206	1.0000	
tax_servic~y	0.0610	-0.0101	-0.0537	0.0917	0.1494	0.2383	1.0000

```
. estat vif
```

Variable	VIF	1/VIF
attitude	1.24	0.804443
tax_system	1.18	0.846085
income	1.18	0.850493
financial_~n	1.14	0.875200
tax_servic~y	1.12	0.891051
occupation	1.01	0.989496
Mean VIF	1.15	

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of tcomp

        chi2(1)      =    0.28
        Prob > chi2  =   0.5981
```

```
. estat ovtest

Ramsey RESET test using powers of the fitted values of tcomp
      Ho:  model has no omitted variables
               F(3, 342) =      2.95
                Prob > F =      0.0328
```

3.1.1. Factors Influencing Tax payers' Compliance Behavior Using Multiple Regression

The factors that significantly contribute to influence go beyond the descriptive analysis and require employing econometric analysis. Multivariate econometric analysis helps us to identify factors that significantly influence the tax compliance behavior. As it discussed in the methodology parts of this study, a multiple regression model was used to identify the major factors influencing taxpayer's compliance behavior on the main effect by keeping interaction variable. The variables described in the descriptive analysis were used as explanatory variables in moderate multiple regression.

The researchers used tax compliance behavior as a dependent variable where by a value of 1 is given to somewhat compliance, 2 for moderate compliance and 3 fully compliance. The following table 3 shows that types, codes and values attached to each variable.

Table 3. Names, types, codes and values of the variables

Names	Types	Codes	Values
		Model 1	
Tax compliance	Dummy	TC2	If taxpayers somewhat1, moderate 2 and fully compliance 3: Here the researcher Decided to be 0 as of 1 and 2 which is non-compliant: and 1 as of 3 which is compliant.
Tax service quality	Scale	TSQ	Based on 1-5 likert scale strongly agree up to strongly disagree
Attitude towards tax evasion	Scale	ATTE	Based on 1-5 likert scale strongly agree up to strongly disagree
Tax system structure	Scale	TS	Based on 1-5 likert scale strongly agree up to strongly disagree
Types of Occupation	Categorical	TO	1,manufacturing 2, merchandise and trade 3,services
Income level	Categorical	IL	1,low level income 2, medium 3, Highe level of income
Financial Condition	Dummy	FC	Satisfaction on generating income for fulfillment their needs

Interaction in sign as well as R^2, adjusted R^2, p value and T values for comparison. Below table 4.9 shows the result of multiple regressions on the relationship between dependent and explanatory variables. Some explanatory variables in the model have the signs that conform to the researcher's prior expectations except a few variables especially in the model. The results of the multiple regressions presented in table 4.10 below. However, before the regressions, the study followed the suggestion of Aiken &West (1991) to center the continuous variables in order to reduce the effect of multicollinearity as cited by Haile H.(2013).

Table 3.2: Result of ordered logistic Regressions for the factors that influence tax compliance behavior

```
. ologit tcomp occupation income financial_condn tax_system attitude tax_servicequality

Iteration 0:   log likelihood = -331.11939
Iteration 1:   log likelihood = -322.11812
Iteration 2:   log likelihood = -322.02571
Iteration 3:   log likelihood = -322.02566
Iteration 4:   log likelihood = -322.02566

Ordered logistic regression                     Number of obs   =        352
                                                LR chi2(6)      =      18.19
                                                Prob > chi2     =     0.0058
Log likelihood = -322.02566                     Pseudo R2       =     0.0275

------------------------------------------------------------------------------
       tcomp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  occupation |   .2793588   .1368572     2.04   0.041     .0111235    .5475941
      income |   .5084052   .2700437     1.88   0.060    -.0208708    1.037681
financial_~n |   .3849183   .2323747     1.66   0.098    -.0705277    .8403643
  tax_system |   .3350911   .1313841     2.55   0.011     .0775831    .5925992
    attitude |  -.124842    .1434156    -0.87   0.384    -.4059314    .1562474
tax_servic~y |   .3386714   .2249988     1.51   0.132     -.102318    .7796609
-------------+----------------------------------------------------------------
       /cut1 |   1.089645   .9837897                     -.8385478    3.017837
       /cut2 |   4.019197    1.01058                      2.038497    5.999897
------------------------------------------------------------------------------
```

The above regression analysis result revealed that **tax system/structure** affects the tax payers' compliance behavior positively and significantly at 1 percent significance level, indicating a positive relationship between compliance behavior and tax system/structure. Bearing in mind of the report, the null hypothesis was that tax system/structure has no significant effect on tax compliance behavior. Since the (P-value) of the fitted value of tax system/structure is (.000) less than (.05), the null hypothesis is rejected. Thus, tax system/structure has a positive and significant effect on tax compliance behavior. Hence, the positive and significant coefficient of the tax system/structure gives support to the previous studies.

Turning to the other explanatory variables, the coefficient of the **tax payers' financial condition** is positive and significant at 10 percent significance level. This significant positive coefficient of tax payers' financial condition shows that, as the level of financial condition of the tax payers increases, the compliance behavior will also tend to increase.

The null hypothesis with this regard was that Tax payers' financial condition has no significant effect on tax compliance behavior. Since the (P-value) of the fitted value of financial condition is (.098) less than (.1), the null hypothesis is rejected. Thus, tax payers' financial condition has significant effect on tax compliance behavior. This result conforms to the previous findings which states that personal financial constraints are believed to have an impact on tax evasion as financial distress faced by an individual may encourage him to prioritize what has to be paid first as basic survival needs (foods, clothing, housing etc.) or where immediate demand on limited income is enforced (i.e. perceived threat of action from money lenders etc.) rather than tax liabilities.

In relation to ***the income***, it more related to financial condition and type of business occupation and it is positive and significant at 10 percent significance level. This significant positive coefficient of tax payers' income shows that, as the level of income of the tax payers increases, the compliance behavior will also tend to increase.

The null hypothesis with this regard was that Tax payers' income has no significant effect on tax compliance behavior. Since the (P-value) of the fitted value of income is (.06) less than (.1), the null hypothesis is rejected. Thus, tax payers' income has significant effect on tax compliance behavior.

Looking at the **type of occupation**, this explanatory variable affects the tax payers' compliance behavior positively and significantly at 5 percent significance level, indicating a positive relationship between compliance behavior and type of occupation. In relation with this variable, the null hypothesis was that tax payers' occupation type has no significant effect on tax compliance behavior. Since the (P-value) of the fitted value of type of occupation (.041) less than (.05), the null hypothesis is rejected. Thus, tax payers' occupation type has a positive and significant effect on tax compliance behavior. With regard to the other three explanatory variables (tax system/structure, tax payers' attitude and income level), the regression analysis result revealed that all the variables have a positive effect but not significantly. Hence, the null hypotheses are accepted.

3.2 Semi- structured Interview

Even though open-ended interview questions are difficult to data analysis, under this study the researcher used content analysis as data reduction techniques that have used extensively to pick out patterns like analysis of key words and phrases. The researcher, after all reading the comments that respondents have provides, and then gets feelings for what people are saying, and offer the following results.

The first question forwarded for respondents, was concerning their perception towards tax evasion, majority of the interviewee 75% responds as they have knowledge while understating income as well overstating income is violating the rules and regulations of tax authority and in case it would have enforcement to pay with punishments. Whereas, 25 percent of the respondents respond if they had get the way as they do it. Having knowledge of the benefits of levying tax-to-tax authority, more than half of the interviewee expresses their perception negatively towards tax evasion. With questions

regarding whether those taxpayers defend other people who evade taxes because of different reasons they respond as they do as well for reasonable aspects since it hinders the government's proper functioning.

The respondents selected via random sampling for the purpose was six from category "C" and the remaining three and one from category "B" and "A" correspondingly. As a result, the former categories respond even if they have positive thinking on timely payment and following the rule and regulations, sometimes intentionally they made defaults that makes them to delay to pay the required amount as a reason due to high burden of tax. As they responded, lastly they lead them to appeal. Furthermore, on the other side under "B" and "A" as they have a reservation on tax system and they believed as they were paying taxes more than others compare to informal business. Except in this case, in other way they described as they governed by the tax authorities rules and regulations like reporting actual income, claiming real deductions, fill return and timely payments with the exception of time limitation to submit the report.

Concerning perceptions of tax system structure, that interviewee replied on the key elements like on tax return forms difficulty to understand, complexity of tax system, bulkiness of tax rules, a need of assistance due to unfair and unclear treatment of tax system, not legitimate way to collect revenue and manage an economy and lastly heaviness of tax burden. More than half 50% of the interviewee responds on the above point that all exits in the current tax system structure except tax system provides a legitimate way to collect revenue and manage an economy. Whereas 40% all items exist in the business profit tax system.

Besides the above-mentioned ideas, survey respondents were also given the opportunity to comment on the tax knowledge and training regarding issue of tax. Accordingly, the respondents replied different responses. Moreover, this summarized as, 40 percent of the respondents have a knowledge how to compute, why and when business tax profit are paying and have get a chance of training in 2007 E.C two wise a year. While 60 percent, of the respondents were respond half of them have knowledge on the above stated and the remaining have no knowledge and did not get training on the tax issues.

Concerning financial constraints, business profit taxpayers respond 25 percent of the interviewee was satisfied with their financial condition after covering personal expenditure and liabilities that were not permitted for deduction by the tax authority and the other 75 percent reveals have financial constraints. Lastly questions forwarded on income level, sources of income and types of occupation they involved. Moreover, 25% of the respondents incorporated in middle-income level and the remaining lower income level and all were self-employed. In addition, all interviewee participates in non-professional occupation.

4. CONCLUSION AND RECOMMENDATION

The relationship between the dependent and independent variable that found in descriptive statistics properly tested using an extended econometric model that includes; tax service quality, tax system structure; attitude towards tax evasion; financial condition, occupation, and non-compliance opportunity/income factors. The substantiation from the study shows that all of them positively affect the tax compliance except attitude. The evidence from the study shows that taxpayers' tax service quality, financial condition, tax system/structure and occupation had a strongly (positive and significant) effect on tax compliance behavior.

As the analysis shown, particularly interview and observation most of them know benefits of paying tax, as a result they have negative attitude towards tax evasion. More of them they don't satisfied as they expected in the overall service quality that are provided by tax officials.

The findings of this study have some interested implications, this study demonstrates the importance of the factors that influence tax compliance behavior, that is the effect cannot be undervalue theoretically and the findings have provided proof in support of the suggestion from the literature.

5. REFERENCES

1. Haile T., (2012).the effect of financial condition in moderating the factor influencing taxpayers' compliance behavior, Ethiopia.
2. Louis k., (2007). The Theory of Taxation and Public Economics, Copyright © 2008 by Princeton University Press Published by Princeton University Press, 41 William Street, Princeton, New Jersey 08540.
3. Lymer, A., and Oats, L. (2009).Taxation: Policy and Practice. 16th ed. Birmingham: Fiscal Publications
4. Osebe R., P, (2013). An Analysis of Factors Affecting Tax Compliance in the Real Estate Sector in Kenya: A Case Study of Real Estate Owners in Nakuru Tow, Nigeria.
5. Torgler, B., &Schaffner, M. (2007).Causes and consequences of tax morale: An empirical investigation. Working paper No 2007-11, CREMA. United Kingdom, July, 12-13 Vol. 37, pp.165-196, York, McGraw-Hill.
6. Mohani and Sheehan, (2004), Tax compliance, self-assessment and tax administration.
7. Dubin and Wilde (1986), A comparison of moderated regression techniques: Considering strength of effects, Journal of Management, vol.8, no.2, pp.35-47. decision. Public Finance Review, Vol. 28, No. 6, pp. 491-521.Fiscal Theory. Public Finance 25, pp. 300 at 302.

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STUDY ON REMOVAL OF CONGO RED DYE ONTO CLEODENDRUM FRAGRANS LEAVES: OPTIMIZATION OF PROCESS PARAMETERS USING RESPONSE SURFACE METHODOLOGY (RSM)

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ABSTRACT

The Objective of the present study is to remove Congo red (CR) dye onto *Cleodendrum fragrans* leaves powder as biosorbent in a batch study. The effect of process variables used were contact time, solution pH, initial CR dye concentration, biosorbent dosage, average particle size of the biosorbent and temperature. The kinetic, isotherm and Thermodynamic studies of removal of CR dye onto *Cleodendrum fragrans* biosorbent were investigated. In the present study Congo red dye uptake was found to be 13.31mg/g by using *Cleodendrum fragrans* leaves as biosorbent. Response surface methodology (RSM) was adopted to study the correlations among the process variables affecting the process and to optimize the process to give high dye removal. The maximum removal efficiency was predicted to be 93.54% at a temperature of 303.48 K, solution pH of 3.99, initial dye concentration of 19.63 mg/L, biosorbent dosage of 1.76 g.

Keywords: Congo red, Cleodendrum fragrance, dye removal, Response Surface Methodology

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1. INTRODUCTION

Water is an irreplaceable natural resource on this earth on which all life depends as a valuable natural resource, it comprises marine, estuarine, fresh water (river and lake) and ground water environments, across costal and inlands areas. Even though there is a huge water resource in this world, about 97% of water is salt water (marine) and only 3% is fresh water, and in this small fraction of fresh water most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water. Due to the pollution created by human beings in this ecosystem, the usable water has decreased drastically and the cost of purifying the water has increased drastically. The main sources of water pollution are point source and non-point source. Point sources include pipeline discharge of pollutants such as domestic sewage discharge, industrial waste effluents from factories or plants to receiving waters **[1]**. The textile industry consumes more than 107 kg of die per year of which 90% ending upon fabrics **[2].** According to the central pollution control board (CPCB), India, there are approximately a million known dye and dye intermediates out of which 5000 are produced commercial, based on their use, dyes are classified into 15 groups. They are acid dyes, azo dyes, basic dyes, direct dyes, food dyes, metal Complex, mordant dyes, whitening agent, pigment dyes, reactive dyes solvent dyes, sulphur dyes and VAT dyes. According to their chemical structure that can be classified into cationic (basic), anionic (direct, acid and reactive dyes) and nonionic dyes (disperse dyes) **[3].** Congo red is an organic compound, the sodium salt of 3,3′-([1,1′-biphenyl]-4,4′-diyl)bis(4-aminonaphthalene-1-sulfonic acid). It is an azo dye. Congo red is water-soluble, yielding a red colloidal solution; its solubility is greater in organic solvents. However, the use of Congo red has long been abandoned, primarily because of its carcinogenic properties. Congo red dye when dissolved in water has a red colour with an absorbance maximum at 497 nm. The removal of dyes from wastewater is so challenging that the government legislation required textile wastewater to be treated constantly with effect to process that can efficiently remove these dyes from wastewater during the past three decades. Biosorption technique was most favorable procedure among all the physico-chemical and adsorption, flocculation combined with flotation, membrane filtration, electrokinetic coagulation, ozonation, oxidation, precipitation and Ion exchange methods **[4, 5].**

2. MATERIALS AND METHODS

2.1. Preparation of dye solution

Stock solutions of Congo red concentration 1000 mg/L was prepared by dissolving 1 g of 100% Congo red in 1000 ml of distilled water. The solution was prepared using standard flasks. The range of concentration of the prepared dye solutions varied between 20 and 200 mg/l was prepared using the stock solution of dye.

2.2. Preparation of biosorbent

The green colored *Cleodendrum fragrans* leaves used in the present study were collected from the college of Engineering, Andhra University, Visakhapatnam, India. The collected leaves were washed with deionised water several times to remove dirt particles. The washing process was continued till the wash water contains no dirt. The washed leaves were then completely dried in sunlight for 20 days. The dried leaves were then cut into small pieces and powdered using domestic mixer. In the present study the powdered materials in the range of 53–152 μm particle size were directly used as biosorbents without any pretreatment.

2.3. Response Surface Methodology

Optimization of different process parameters depending on the dye removal is highly required for the effective design and accurate control of biosorption technique. So, response surface methodology is time saving and precise alternative to conventional optimization methods. The main objective is to optimize the response surface that is shaped under the influence of process parameters.The effect of different process parameters such as temperature (X_1), solution pH (X_2), biosorbent dosage (X_3) and initial dye concentration (X_4) on Congo red dye removal onto *Cleodendrum fragrans* leaves were studied by using full factorial rotatable central composite design (CCD). Total thirty experiments, which include 16 cube point runs, 8 axial point runs and 2 centre point, 4 dummy runs were required and all of them were done in duplicate. All the experiments were conducted at contact time (t) and a constant speed of agitation 180 rpm.All independent variables were coded to five levels as X_i according to Eqn.1.

$$X_i = \frac{(X_i - X_{oi})}{\Delta X_i},\ i= 1, 2, 3,\ldots\ldots\ldots k \qquad \text{----Equ.1}$$

Where X_i is the dimensionless value of an independent variable, x_i is the real value of an independent variable, x_{0i} is the real value of the independent variable at the centre point, and Δx_i is the step change. A second degree polynomial equation (Eqn. 2) was developed to estimate the percentage of biosorption of dye at different operating conditions of the biosorption process by using STATISTICA 6.0 (Stat Soft Inc.).

$$Y=b_0+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_{11}X_1^2+b_{22}X_2^2+b_{33}X_3^2+b_{44}X_4^2+b_{12}X_1X_2+b_{13}X_1X_3+b_{14}X_1X_4+b_{23}X2X_3+b_{24}X_2X_4+ b_{34}X_3X_4 \qquad \text{----Equ.2}$$

Where , Y is the predicted response, X_1, X_2, X_3 and X_4 are independent variables: b_0 is an offset term; b_1,b_2,b_3 and b_4 are linear effects; b_{11}, b_{22}, b_{33} and b_{44} are squared effects and b_{12}, b_{13}, b_{14}, b_{23}, b_{24} and b_{34} are interaction terms.

3. RESULTS AND DISCUSSION

3.1. Effect of contact time

The effect of contact time on the biosorption process using *Cleodendrum frangrans leaves* as biosorbent was studied separately by varying initial dye concentrations (20 – 200 mg/L) at solution pH 7, temperature 303 K and constant speed of agitation 180 rpm. The percentage of biosorption and dye uptake values were determined at different contact times. The percentage of biosorption and dye uptake were steeply increased

with an increase in contact time from 5 to 25 min for Congo red and thereafter reached plateau after attaining equilibrium at 25 min for Congo red. The rapid biosorption at the early stages of contact period indicates the availability of a greater number of accessible sites on the surface of the biosorbent and also due to increase in the concentration gradient between adsorbate in solution and adsorbate on the biosorbent surface. At later stages of biosorption, the external biosorbent surface was saturated with dye molecules, thus the biosorption proceeds on interior walls of the biosorbent surface. The slower biosorption rate towards equilibrium was due to the availability of less number of available vacant sites on the biosorbent surface and also the repulsive forces between the adsorbed dye molecules on the biosorbent surface and dye molecules present in the aqueous solution.

3.2. Effect of solution pH

The solution pH is one of the important controlling parameters of the biosorption process. The effect of solution pH on % biosorption and equilibrium dye uptake of *Cleodendrum frangrans leaves* biosorbent for the removal of Congo red dye was studied separately at different initial concentration of dyes (20 to 200 mg/L), temperature of 303 K and constant speed of agitation 180 rpm by varying solution pH from 2 to 8. The biosorption of Congo red was strongly pH dependent. The % biosorption and dye uptake of the biosorbent were low at solution pH 2 and increased gradually with an increase in pH from 2 to 4 for Congo red and thereafter decreased with further increase in pH from 4 to 8. The variation in the % biosorption and dye uptake with change in pH was due to the influence of solution pH on the activity of functional groups present on the biosorbent surface and chemical properties of dye molecules present in the aqueous solution.

3.3. Effect of initial concentration of dye

The effect of initial dye concentration for the biosorption of Congo red was studied at concentration range from 20 to 200 mg/L at a fixed dosage of biosorbent 0.5 g for 50 ml of solution, average particle size of 53 µm, temperature in the range 283 - 323K, solution pH 4 and constant speed of agitation 180 rpm. The percentage of biosorption was decreased and the dye uptake was increased for the dye.

3.4. Effect of biosorbent dosage

Biosorbent dosage is an important parameter in biosorption studies, because this factor determines the capacity of a biosorbent for a given initial concentration of biosorbate. The influence of biosorbent dosage on the biosorption of Congo red dye from aqueous solution was studied for initial dye concentration of 20 -200 mg/L at solution pH 4 for Congo red, temperature 303 K and constant speed of agitation 180 rpm by varying the biosorbent dosage from 0.5 to 4 g. The percentage of biosorption was increased with an increase in biosorbent dosage and the dye uptake was decreased with an increase in biosorbent dosage.

3.5. Effect of particle size of biosorbent

The effect of average particle size of the biosorbent on the biosorption of the dye, Congo red was investigated with solution having different initial dye concentrations (20 - 200 mg/L) at solution pH 4, temperature 303K and constant speed of agitation

180 rpm by varying the average particle size of biosorbent from 53 to 152 µm. The percentage of biosorption and dye uptake was decreased with an increase in average particle size of biosorbent. This could be due to the fact that the smaller particles have shortened diffusion paths and increases total surface area, and therefore, the ability to penetrate all internal pore structures of biosorbent is very high.

3.6. Effect of Temperature

The influence of temperature on the biosorption of Congo red dye was studied for initial dye concentration of 20-200 mg/L at solution pH 4, constant speed of agitation 180 rpm, and temperature of 283, 293, 303, 313, and 323 K. The percentage of biosorption and dye uptake were increased with an increase in temperature of the solution. This suggests the endothermic nature of the biosorption process.

3.7 Equilibrium studies

The equilibrium isotherm studies provide the equilibrium relationships between biosorbent and adsorbate and also give the information for the calculation of capacity of the biosorbent for an adsorbate. Equilibrium data is highly essential for the efficient design, operation and control of biosorption systems. Thus, it is highly important to establish the most appropriate equilibrium model which gives the true equilibrium data. Therefore, the isotherm results were analyzed using the Langmuir, Freundlich and Temkin models.

3.8 Kinetic Studies

The kinetics of biosorption studies describe the solute uptake rate and residence time of sorption reaction. These parameters are highly essential for efficient design of biosorption process. The kinetic data provides the necessary information required for optimizing the operating conditions in full scale batch biosorption process. The kinetic data also helps in determining the rate limiting step involved in the biosorption process. Hence, kinetic models were tested for the biosorption of Congo red dye using *Cleodendrum fragrans* leaves as biosorbent.

3.9 Thermodynamic Studie

Thermodynamic studies provide information about the feasibility of the process and nature of biosorption process. In order to estimate the thermodynamic parameters for the biosorption of Congo red dye using *Cleodendrum fragrans* leaves leaves as biosorbent, the experiments were conducted and data were analyzed. The values of $\Delta H°$ and $\Delta S°$ were calculated from the slope and intercept of the linear Van't Hoff plot i.e $\ln (q_e/c_e)$ vs $(1/T)$. It is apparent from the results that the values of ΔG^0 were obtained at studied experimental conditions. The values of ΔG^0 indicate the spontaneous nature of the biosorption process and confirm the feasibility of the biosorption process. The decrease in values of ΔG^0 with increase in temperature shows an increase in feasibility of biosorption at higher temperature. These results are also in conformity with the results of adsorption isotherms (Langmuir isotherm).The results also revealed that the biosorption process is endothermic in nature, because ΔH^0 possess positive values. The

positive value of ΔS° indicates that the increased randomness at the solid-solute interface during biosorption process.

4. Optimization of biosorption process parameters using response surface methodology (RSM)

The response surface methodology is a collection of useful mathematical and statistical technique for analyzing the effects of several independent variables on response of interest. The main objective of RSM is to determine the optimum operational variables of the process. It is also used to evaluate the relative significance of process variables even in the presence of complex interactions. RSM offers certain advantages in adsorption process like improved percentage yield, closer confirmation of the output response to nominal and target requirements, reduced process variability and reduced developmental time and overall costs. Therefore, the aim of the present study is to conduct Congo red biosorption onto *Cleodendrum frangrans* leaves biosorbent and to investigate the combined effects of various process variables on percentage of biosorption using central composite design in response surface methodology. The variables such as temperature, solution pH, dosage of the biosorbent and initial dye concentration are all the four essential parameters of biosorption studies, significantly affected the percentage of biosorption of the dye and dye uptake of the biosorbent. Hence, these four variables were selected as independent variables to find the optimized conditions for maximum percentage of biosorption of Congo red dye onto *Cleodendrum frangrans* leaves biosorbent using response surface methodology.The influence of various process parameters such as temperature (x_1), solution pH (x_2), biosorbent dosage (x_3) and initial dye concentration (x_4) on the biosorption of Congo red onto the biosorbent was studied by using full factorial central composite design (CCD). The response was expressed as the percentage of biosorption of Congo red dye. A central composite design with 30 experiments, which includes 16 cube point runs, 8 center point runs, 2 axial point runs and 4 dummy runs, was used for the optimization of process variables for the removal of Congo red dye from aqueous solution.The Levels of different process variables used in CCD for the biosorption of Congo red dye onto *Cleodendrum frangrans* leaves biosorbent as shown in Table-1 and An Experimental design matrix along with percentage of biosorption of Congo red dye onto *Cleodendrum frangrans* leaves biosorbent as shown in Table-2.

Table-1. Levels of different process variables used in CCD for the biosorption of Congo red dye onto *Cleodendrum frangrans* leaves biosorbent.

Variable	Name	Range and levels				
		-2	-1	0	1	2
X_1	pH of aqueous solution	2	3	4	5	6
X_2	Initial concentration, C_o, mg/L	10	15	20	25	30
X_3	Biosorbent dosage, w, g	1.25	1.5	1.75	2	2.25
X_4	Temperature, T, K	283	293	303	313	323

Table-2. Experimental design matrix along with percentage of biosorption of Congo red dye onto *Cleodendrum frangrans* leaves biosorbent

Experimental Run no	x_1	x_2	x_3	x_4	% Biosorption of Congo red	
					Experimental	
					76.4800	Predicted
1	-1	-1	-1	-1	76.9800	76.4917
2	-1	-1	-1	1	77.7200	77.0375
3	-1	-1	1	-1	78.6000	77.7075
4	-1	-1	1	1	75.7200	78.5883
5	-1	1	-1	-1	76.3000	75.6875
6	-1	1	-1	1	76.3800	76.3183
7	-1	1	1	-1	77.3800	76.4483
8	-1	1	1	1	76.9800	77.4142
9	1	-1	-1	-1	77.3200	76.9708
10	1	-1	-1	1	77.6800	77.2817
11	1	-1	1	-1	78.2800	77.6917
12	1	-1	1	1	75.8800	78.3375
13	1	1	-1	-1	76.2800	75.9217
14	1	1	-1	1	76.2200	76.3175
15	1	1	1	-1	76.9000	76.1875
16	1	1	1	1	70.5200	76.9183
17	-2	0	0	0	70.4800	70.4808
18	2	0	0	0	79.3800	70.4642
19	0	-2	0	0	77.2000	79.3742
20	0	2	0	0	77.9800	77.1508
21	0	0	-2	0	79.8200	77.9642
22	0	0	2	0	79.5800	79.7808
23	0	0	0	-2	80.9200	79.5842
24	0	0	0	2	93.5000	80.8608
25	0	0	0	0	93.5000	93.5000
26	0	0	0	0	93.5000	93.5000
27	0	0	0	0	93.5000	93.5000
28	0	0	0	0	93.5000	93.5000
29	0	0	0	0	93.5000	93.5000
30	0	0	0	0		

The coefficient of determination (R^2) value provides a measure of variability in the observed response that can be explained by the experimental process variables and their interactions. The coefficient of determination (R^2) is found to be 0.996 for Congo red indicates that high correlation between the observed and predicted values. For further validation of the model, adjusted R^2 was used for confirming the model competence. The adjusted R^2 was found to be 0.99 for Congo red, which indicates that the proposed model was fitted well with the experimental data. These results indicate that the predicted R^2 values are in reasonable agreement with the adjusted R^2 values. The value of coefficient of determination indicates that 99% variation in the biosorption of Congo red is attributed to the independent variables explained by the model. The Parity plot for Congo red biosorption shown in fig1.

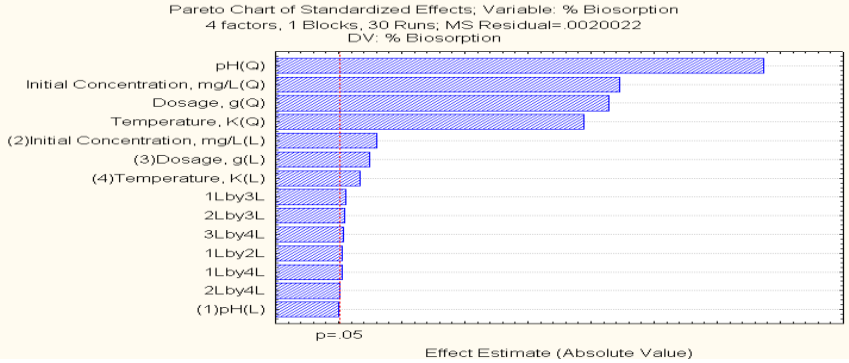


Fig.1. Parity plot for Congo red biosorption.

The significance of each parameter was evaluated by student t test and p values for Congo red, Response surface regression coefficient for removal of Congo red is given in Table.3. From these results the P values were found to be 0. 0.000064, 0.000098, 0.076887 and 0.000002. This implies that the linear effects of temperature, solution pH, dosage and initial dye concentration are highly significant for Congo red. Apart from the linear effects of the variables, the RSM also gives an insight into the quadratic and interaction effects of the process variables. It is evident from the results that the quadratic effect of all independent variables for Congo red was highly significant because their P-values were less than 0.05. As mentioned in Table.3, the magnitude of t –values give the positive or negative influence on the dependent variable. The linear terms of temperature, solution pH, biosorbent dosage and initial dye concentration have positive influence on the percentage of biosorption. The quadratic terms of temperature, solution pH, biosorbent dosage and initial dye concentration shows a negative influence on biosorption process for Congo red dye. The interaction effect was found to be significant for solution pH and biosorbent dosage for Congo red. Whereas interaction effects between remaining variables were found to be statistically insignificant because their P-values were > 0.05.

Table 3.Response surface regression coefficients for removal of Congo red

Term	Coeff.	SE coeff.	t-value	P-value
const	-3291.25	8.531229	-385.789	0.000000
x_1	48.94	0.357461	136.916	0.000000
x_2	-5.76	0.008544	-673.802	0.000000
x_3	6.06	0.071492	84.811	0.000000
x_4	-0.15	0.000342	-445.861	0.000000
x_1^2	200.25	1.460324	137.128	0.000000
x_2^2	-58.51	0.136702	-428.012	0.000000
x_3^2	20.10	0.052754	381.087	0.000000
x_4^2	-0.03	0.000085	-388.510	0.000000
x_1x_2	-0.01	0.002237	-5.475	0.000064
x_1x_3	-0.49	0.044746	-11.062	0.000000
x_1x_4	-0.01	0.001119	-5.252	0.000098
x_3x_2	-0.09	0.008949	-10.168	0.000000
x_4x_2	0.00	0.000224	1.900	0.076887
x_3x_4	0.03	0.004475	7.487	0.000002

The statistical significance of these regression model equations was evaluated by the F-test ANOVA. The significance of each variable was determined by F-values and p-values. It was observed from the Table .4. That the F statistic values for all regression were higher, which indicate that the developed models were highly significant and adequate to represent the relationship between the percentage of biosorption of the dye and process parameters. The larger fisher F- value with a low probability values (<0.05) demonstrate that the developed mathematical models were fitted well to the experimental data. From the ANOVA results, it is evident that the linear and quadratic effects were highly significant in comparison with interaction effects for the dye. However, for Congo red, solution pH and biosorbent dosage were significant Optimum values of variables obtained from regression equations for the removal of Congo red dye by *Cleodendrum fragrans* shown in Table-5.

Table 4. Analysis of variance for removal of Congo red dye

Factors	SS	Df	MS	F	P
x_1	0.000	1	0.0004	0.2	0.654794
x_2	909.027	1	909.0270	454009.1	0.000000
x_3	7.415	1	7.4148	3703.3	0.000000
x_4	398.025	1	398.0253	198791.8	0.000000
x_1^2	4.950	1	4.9504	2472.5	0.000000
x_2^2	366.795	1	366.7950	183194.0	0.000000
x_3^2	2.445	1	2.4448	1221.1	0.000000

x_4^2	302.215	1	302.2149	150939.7	0.000000
x_1x_2	0.060	1	0.0600	30.0	0.000064
x_1x_3	0.245	1	0.2450	122.4	0.000000
x_1x_4	0.055	1	0.0552	27.6	0.000098
x_3x_2	0.207	1	0.2070	103.4	0.000000
x_4x_2	0.007	1	0.0072	3.6	0.076887
x_3x_4	0.112	1	0.1122	56.1	0.000002
Error	0.030	15	0.0020		
Total SS	1445.239	29			

Table 5. Optimum values of variables obtained from regression equations for the removal of Congo red dye by *Cleodendrum fragrans*.

Parameter	Optimum value for Congo red dye
Solution pH	3.9991
Initial dye concentration, mg/l	19.6312
Biosorbent dosage, g	1.7660
Temperature, K	303.4865
% Biosorption	93.54

The response surface contour plots of the percentage of biosorption of dye versus the interactive effect of all the process parameters are shown in Figs.2 to 7 for Congo red dye.

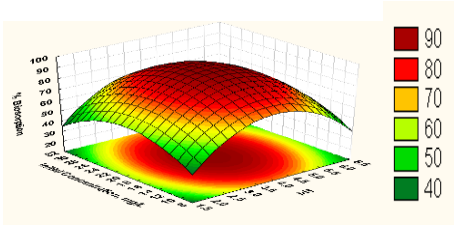


Fig.2. Response surface plot of solution pH vs initial dye concentration for the biosorption of Congored.

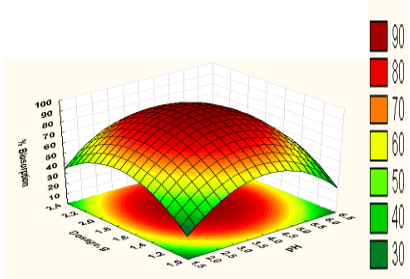


Fig.3. Response surface plot of solution pH vs Biosorbent dosage for the biosorption of Congo red.

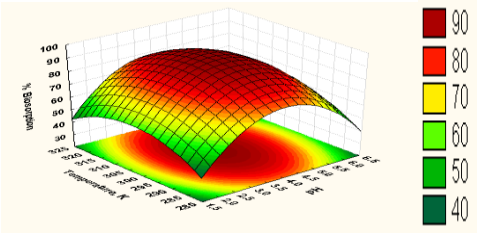


Fig.4. Response surface plot of solution pH vs temperature for the biosorption of Congo red.

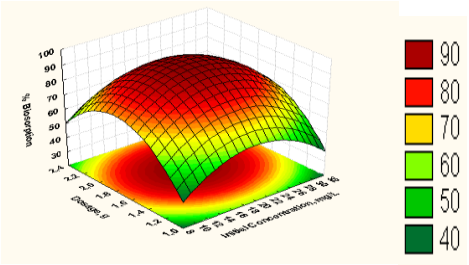


Fig.5. Response surface plot of initial dye concentration vs biosorbent dosage for the biosorption of Congo red.

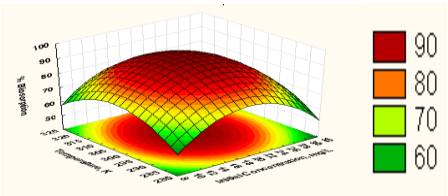


Fig.6. Response surface plot of initial dye concentration vs temperature for the biosorption of Congo red

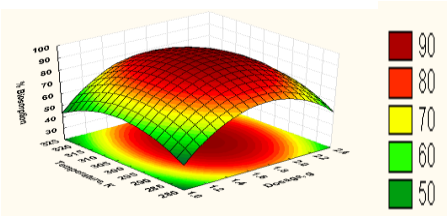


Fig.7. Response surface plot of biosorbent dosage vs temperature for the biosorption of Congo red

The maximum percentage of biosorption of level is indicated by the surface confined in the smallest curve (circular or elliptical) of the response plot. The optimal set of

conditions for maximum percentage of biosorption of Congo red is pH = 3.99, initial concentration of dyes in aqueous solution = 19.63 mg/L, biosorbent dosage = 1.76 g and temperature = 303.48 K. The extent of biosorption of Congo red at these optimum conditions was 93.54 %. The optimum values for process variables obtained by using response surface methodology were verified by conducting experiments at these optimum conditions. It was found that the maximum % biosorption of 93.54% for Congo red was obtained at these optimum parameters. These results are very nearer to that of the results of RSM studies, which proved that the statistical experimental design using RSM could be effectively used to optimize various process parameters for improving the biosorption of Congo red dye onto *Cleodendrum frangrans* leaves biosorbent.

4. CONCLUSION AND RECOMMENDATION

The optimization of experimental parameters like temperature, solution pH, biosorbent dosage and initial dye concentration were carried out using response surface methodology (RSM) with central composite design (CCD) for the removal of Congo red dye onto *Cleodendrum Frangrans* biosorbent. The optimized process variables obtained from the RSM for the biosorption of Congo red were in close agreement with the experimental data. The maximum removal efficiency was predicted to be 93.54% at a temperature of 303.48 K, solution pH of 3.99, and initial dye concentration of 19.63 mg/L and biosorbent dosage of 1.76g.

5. REFERENCES

1. Ramachandra, T.V., Ahalya, N., Rajasekara Murthy C. Aquatic ecosystems: conservation, restoration and management, Capital Publishers, New Delhi, (2005).
2. Kassim, T.L.S.M.J.N.M. Acidic and Basic Dyes Removal by Adsorption on Chemically Treated Mangrove Barks, International Journal of Applied Science and Technology, 2(3) (2012) 270-276.
3. S. Mishra, G., Tripaty, M. A critical review of the treatments for decolourization of textile effluent, Color age, 40 (1993) 35-38.
4. Sulak, M.T., Demirbas, E., Kobya, M. Removal of Astrazon Yellov.1 7GL from aqueous solution onto wheat bran J. Biores. Technol., 98 (2007) 2590-2598.
5. Xie, K., Zhao, W., He, X. Adsorption properties of nan10-cellulose hybrid. Dyes from aqueous solution, Carbo hyd . Polym., 83 (2011) 1516-1520.
6. Ho, Yuh-Shan, and Gordon McKay. "Sorption of dye from aqueous solution by peat." Chemical engineering journal, 70 (2) (1998) 115-124.
7. Kavitha, D., and C. Namasivayam. "Experimental and kinetic studies on methylene blue adsorption by coir pith carbon."Bioresource Technology, 98 (1) (2007) 14-21.
8. Tan, Boon Hai, Tjoon Tow Teng, and AK Mohd Omar. "Removal of dyes and industrial dye wastes by magnesium chloride." Water research, 34 (2) (2000) 597-601.
9. Namasivayam, C., N. Muniasamy, K. Gayatri, M. Rani, and K. Ranganathan. "Removal of dyes from aqueous solutions by cellulosic waste orange peel." Bioresource Technology, 57 (1) (1996) 37-43.

10. Garg, Vinod K., Moirangthem Amita, Rakesh Kumar, and Renuka Gupta. "Basic dye (methylene blue) removal from simulated wastewater by adsorption using Indian Rosewood sawdust: a timber industry waste." Dyes and pigments, 63 (3) (2004) 243-250.
11. Namasivayam, C., R. Radhika, and S. Suba. "Uptake of dyes by a promising locally available agricultural solid waste: coir pith." Waste management, 21 (4) (2001) 381-387.
12. Qu, Song, Fei Huang, Shaoning Yu, Gang Chen, and Jilie Kong. "Magnetic removal of dyes from aqueous solution using multi-walled carbon nanotubes filled with Fe2O3 particles."Journal of Hazardous Materials, 160 (2-3) (2008) 643-647.
13. Garg, V. K., Rakesh Kumar, and Renuka Gupta. "Removal of malachite green dye from aqueous solution by adsorption using agro-industry waste: a case study of Prosopis cineraria."Dyes and Pigments 62, no. 1 (2004): 1-10.
14. Forgacs, Esther, Tibor Cserhati, and Gyula Oros. "Removal of synthetic dyes from wastewaters: a review." Environment international, 30(7) (2004) 953-971.
15. Gong, Renmin, Yi Ding, Mei Li, Chao Yang, Huijun Liu, and Yingzhi Sun. "Utilization of powdered peanut hull as biosorbent for removal of anionic dyes from aqueous solution." Dyes and Pigments, 64 (3) (2005) 187-192.
16. Garg, Vinod K., Moirangthem Amita, Rakesh Kumar, and Renuka Gupta. "Basic dye (methylene blue) removal from simulated wastewater by adsorption using Indian Rosewood sawdust: a timber industry waste." Dyes and pigments, 63 (3) (2004) 243-250.
17. Kannan, Nagarethinam, and Mariappan Meenakshi Sundaram. "Kinetics and mechanism of removal of methylene blue by adsorption on various carbons—a comparative study." Dyes and pigments, 51 (1) (2001) 25-40.
18. Namasivayam, C., and Dyes Kavitha. "Removal of Congo Red from water by adsorption onto activated carbon prepared from coir pith, an agricultural solid waste." Dyes and pigments, 54 (1) (2002) 47-58.
19. Amin, Nevine Kamal. "Removal of reactive dye from aqueous solutions by adsorption onto activated carbons prepared from sugarcane bagasse pith." Desalination, 223(1-3) (2008) 152-161.
20. Papić, Sanja, Natalija Koprivanac, Ana Lončarić Božić, and Azra Meteš. "Removal of some reactive dyes from synthetic wastewater by combined Al (III) coagulation/carbon adsorption process." Dyes and pigments, 62(3) (2004) 291-298.
21. Lata, Hem, V. K. Garg, and R. K. Gupta. "Removal of a basic dye from aqueous solution by adsorption using Parthenium hysterophorus: an agricultural waste." Dyes and pigments, 74(3) (2007) 653-658.
22. Moussavi, Gholamreza, and Maryam Mahmoudi. "Removal of azo and anthraquinone reactive dyes from industrial wastewaters using MgO nanoparticles." Journal of Hazardous Materials, 168 (2-3) (2009) 806-812.
23. Garg, V. K., Rakesh Kumar, and Renuka Gupta. "Removal of malachite green dye from aqueous solution by adsorption using agro-industry waste: a case study of Prosopis cineraria." Dyes and Pigments, 62 (10 (2004) 1-10.
24. Robinson, T., B. Chandran, and P. Nigam. "Removal of dyes from an artificial textile dye effluent by two agricultural waste residues, corncob and barley husk." Environment International, 28 (1-2) (2002) 29-33.

25. Al-Ghouti, M. A., M. A. M. Khraisheh, S. J. Allen, and M. N. Ahmad. "The removal of dyes from textile wastewater: a study of the physical characteristics and adsorption mechanisms of diatomaceous earth." Journal of Environmental Management 69 (3) (2003) 229-238.
26. Chuah, T. G., A. Jumasiah, I. Azni, S. Katayon, and SY Thomas Choong. "Rice husk as a potentially low-cost biosorbent for heavy metal and dye removal: an overview." Desalination, 175 (3) (2005) 305-316.
27. Khraisheh, M. A. M., M. A. Al-Ghouti, S. J. Allen, and M. N. Ahmad. "Effect of OH and silanol groups in the removal of dyes from aqueous solution using diatomite." Water Research, 39 (5) (2005) 922-932.
28. Khattri, S. D., and M. K. Singh. "Removal of malachite green from dye wastewater using neem sawdust by adsorption."Journal of Hazardous Materials, 167 (1-3) (2009)1089-1094.
29. Mckay, G. B. H. S., H. S. Blair, and J. R. Gardner. "Adsorption of dyes on chitin. I. Equilibrium studies." Journal of applied polymer science, 27 (8) (1982) 3043-3057.
30. El-Geundi, Mohammad S. "Colour removal from textile effluents by adsorption techniques." Water Research, 25 (3) (1991) 271-273.
31. Aksu, Zümriye, and Sevilay Tezer. "Equilibrium and kinetic modelling of biosorption of Remazol Black B by Rhizopus arrhizus in a batch system: effect of temperature." Process Biochemistry, 36 (5) (2000) 431-439.
32. Al-Degs, Yahya S., Musa I. El-Barghouthi, Amjad H. El-Sheikh, and Gavin M. Walker. "Effect of solution pH, ionic strength, and temperature on adsorption behavior of reactive dyes on activated carbon." Dyes and pigments, 77 (1) (2008) 16-23.
33. Wang, Shaobin, Huiting Li, and Longya Xu. "Application of zeolite MCM-22 for basic dye removal from wastewater."Journal of colloid and interface science, 295 (1) (2006) 71-78.
34. Gupta, V. K., I. Ali, and Dinesh Mohan. "Equilibrium uptake and sorption dynamics for the removal of a basic dye (basic red) using low-cost adsorbents." Journal of colloid and interface science, 265 (2) (2003) 257-264.
35. Daneshvar, N., M. Ayazloo, A. R. Khataee, and M. Pourhassan. "Biological decolorization of dye solution containing Malachite Green by microalgae Cosmarium sp."Bioresource technology, 98 (6) (2007)1176-1182

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A Cross-Sectional Study on the Prevalence and Financial Loss Attributed to Hydatidosis in Cattle Slaughtered at Bahir Dar Municipal Abattior, Bahir Dar, Ethiopia

Wossene Negash[1*], Adugnaw Asmare[1], Teshager Dubie[1]

ABSTRACT

Hydatidosis is a public health hazard in Ethiopia. The status of the disease in the study districts has not been elucidated. Hence, the current cross-sectional study was designed and conducted from December 2017 to April 2018 in an attempt to determine the prevalence and financial losses associated with bovine hydatidosis on cattle slaughtered at Bahir dar Municipal Abattoir and identify potential risk factors were identified.

Applying simple randomly sampling method, both adult and old male cattle animals were selected prior to slaughter. Antemortem and postmortem examination methods were made during the study. During antemortem examination, relevant data including sex, origin of animals (districts), body condition, age and clinical signs were collected. Similarly, postmortem inspection was conducted to examine the existence of hydatid cysts in the organs under study (liver and lungs) for each animal following the standard meat inspection procedures.

Of 384 heads of cattle slaughtered and examined, 127 were found positive for *Echinococcos granulosus* with an overall prevalence of 33.05%, computed by standard statistical methods. No statistically significant association detected between selected risk factors (P> 0.05) and the disease. The prevalence of hydatid cysts by organs included: 46 (11.97%), 45 (11.71%), and 36 (9.375%) for lungs, livers, and both lung and liver, respectively. The annual financial loss due to organ condemnation and live carcass weight loss associated to bovine hydatidosis at the study abattoir was estimated to be 10,531,776.12 ETB/385,496.93USD. The current study has revealed a higher prevalence of bovine hydatidosis in the study districts urging prompted and collaborative actions to be set in place.

Keywords: Abattior, cattle, Financial loss, Hydatidosis, Prevalence Risk factors

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1. INTRODUCTION

Ethiopia leads the African content in livestock population with each species estimated at 57.8 million heads of cattle, 28.89 million sheep, and 29.7million goats as of CSA (2016). Dominantly, livestock serve as source of cash income, food, draught power and main national source of foreign currency. However, in Ethiopia, livestock productivity remained at its marginal level mainly attributed to mismanagement, limited genetic improvement, feed shortage and rampancy in animal diseases. Of livestock diseases causing serious problems, parasitism holds the biggest share in the tropics (FAO, 2011). Among parasitic diseases, metacestode in domestic ruminants inflicts enormous economic damage due to the condemnation of affected organs and lowering of meat, milk and wool production. The metacestode is passively transferred to the definitive host when the latter ingests the infected intermediate host (Soulsby, 1982). Infection with *Echonococos granulosus*, the stage of the parasitic tapeworm is recognized as one of the world's major zoonosis affecting both humans and domestic animals (Cringoli *et al*., 2007). The two most important species of *Echinococcus* are *Echinococcus granulosus*, *E.multilocularis*, with the larval stage developing in a very wide range of intermediate hosts including man (Smyth, 1994).

The definitive hosts for *Echinococcus granulosus* are dogs which harbor adult tape worms and excrete the parasites' eggs along with their feces whilist livestock and human are the main intermediate hosts (Oku *et al*., 2004). Transmission of the adult worm residing within the small intestine of the definitive host (dogs) begins when gravid proglottids release eggs that are passed along with dogs' feces and ingested by an intermediate host (cattle ingest the eggs during grazing). Once in the small intestine, eggs hatch and release oncospheres that penetrate the intestinal wall and move through the circulatory system into different organs, in particular the liver and lungs (John *et al*., 2006).

Many studies conducted on different abattoirs on the prevalence of hydatidosis and financial losses. However, evidences pertaining to the current status of bovine hydatidosis and the magnitude of financial losses it poses in the selected districts were unavailable. Therefore, the objectives of the current study were to assess the current prevalence of hydatidosis in cattle slaughtered at Bahir Dar Abattoir, assess associated risk factors and estimate direct and indirect losses due to organ condemnation.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted from December 2017 to April 2018 on cattle slaughtered at Bahir Dar municipal abattoir originated were from four districts namely Adet, Este, Zenzelima and Merawi of Gojam zone, Amhara region, Ethiopia.

2.2 Study population

The study was undertaken on local zebu cattle intended for slaughter at Bahir dar municipal abattoir. Study cattle were males aged adult and above. Animals slaughtered

at the abattoir were purchased from local markets whose actual source was the study districts mentioned so far.

2.3 Study design

A cross sectional type of study design was applied for the study.

2.4 Sampling method and sample size determination

The study sites were purposely selected whereas each study animal for inspection was selected randomly. The total sample size required for the study was determined using Thrusfield formula (Thrusfield, 2005) with 95% confidence interval and 5% absolute precision.

2.5 Antemortum and postmortem examinations

Antemortally, each animal was examined clinically both at rest and in motion with provision of identification number. Age was estimated using teeth eruption approach (De-Lahunta and Habel 1986). Based on age, study animals were divided into two groups: adult (≤ 5 years) and old (>5 years) according to (Pasquini and Spurgeon, 2003).

Inspection of target organs (liver and lung) was performed to confirm existence/absence of hydatid cysts applying meat inspection procedures. Initially, visualization and palpation of organs (liver, lung) was carried followed by further incisions for confirmation of cyst presence or absence.

2.6 Financial loss analysis

The annual financial loss due to hydatidosis was estimated by summing up cost of offals condemned and cost of carcass weight losses due to parasite infection (Kebede *et al*., 2009; Getaw *et al*., 2010). The annual number of cattle slaughtered at the abattoir was determined based on retrospective analysis of data recorded over one year (2017/2018). As a result, the annual cattle slaughtering capacity of the abattoir was estimated to be 4720 cattle in that year.

2.7 Direct financial loss

Direct financial loss was calculated based on the number of condemned organs, annual average number of animals slaughtered at the abattoir, percent involvement of organs out of total examined (rate of organ condemnation) and average market prices of condemned organs. Thus, the annual financial loss incurred due to condemned organs due to hydatidosis was calculated using formula set by Zewdu *et al*., (2010).

$$LOC = (pI1xTkxc1) + (pI2xTkxc2) \quad \text{----Equ.1}$$

Where; LOC=loss from organs condemnation

PI1 = percent involvement of lung out of total examined, PI2 = percent involvement of liver out of total examined,C1 = average market price of lung, C2 = average market price of liver, Tk = average annual kill of bovines).

2.8 Indirect financial loss

Indirect loss was calculated based on live weight reduction due to hydatidosis, average carcass weight of local adult zebu cattle which was 126 kg (ILCA, 1979), prevalence of bovine hydatidosis and average local price of one kg of beef using the formula set by Ogunirade *et al.* (1981). ACW = CSR × CL × BC × P, Where: ACW = Annual cost from carcass weight loss; CSR = average slaughtered cattle per annual in the

abattoir; CL = carcass weight loss in the individual = (126×5%); BC = average price of 1 kg carcass at town=Bahir dar 190 ETB ; P = prevalence of hydatidosis at Bahir Dar municipal apattior.

2.9 Data management and analysis

Relevant data obtained was coded and entered in Microsoft excel system and further analyzed using IBM SPSS version 20.0. Descriptive statistics was employed to determine the prevalence and frequencies while chi-square test was computed to assess the association between organ condemnation and risk factors.

3. RESULT ANALYSIS

3.1 Overall prevalence

Of 384 cattle slaughtered at study abattoir, 127(33.05%) of them harbored hydatid cyst in one or more of their visceral organs as presented in the table 1. All cattle slaughtered were male aged adult and above.

Table 1. Over all prevalence of bovine hydatidosis in Bahir Dar municipal Abattoir

Cattle examined	Number of postive	Prevalance(%)
384	127	33.05

3.2 Analysis of associated risk factors

Prevalence of bovine hydatidosis was determined based on risk factors: age, origin and body condition score of animals. No statistically significant association found between the disease and risk factors (P>0.05).

3.3 Analysis of risk factors

The prevalence of bovine hydatidosis based on the age of slaughtered animals was computed to 37.6% and 29.32 % in adult and old, respectively. No statistically significant association between age groups and the disease (P>0.05). Similarly, the prevalence of bovine hydatidosis in line with body condition score was determined to be, 37.5%, 31.6.02% and 30.92% in poor, medium and good body condition scores, respectively with no statistically significant association with the disease(P>0.05) as shown in the table 2.

As indicated in table 2, the prevalence of bovine hydatidosis with respect to origins of the animals slaughtered were found to 38.23%, 28.2 %, 36% and 38.58% for Adet, Este, Zenzelima and Merawi, respectively with no statistically significant association (P>0.05) with the disease.

Table 2. The prevalence of bovine hydatidosis among different risk factors

Variable	Not examined	No positive	Prevalance	X^2	P- value
Age					
Adult	176	66	37.6%	4.939	0.176
Old	208	61	29.32%		
BCS					
Good	97	30	30.92%	10.282	0.093
Moderate	183	58	31.6%		
Poor	104	39	37.5%		
Origin					
Adet	102	39	38.23%	8.893	0.447
Este	117	33	28.2%		
Zenzelima	80	29	36%		
Merawi	85	26	30.58%		

Table 3: Distribution of hydatid cysts in different organs and proportion of organs involved in the study animals

Organ infected	Examined	No of cases	Prevalance	Proportion from infected
Lung only	384	46	11.97%	36.22%
Liver only	384	45	11.71%	35.48%
Lung and liver	384	36	9.375%	28.4%
total	384	127	33.05%	100%

3.4 Financial loss estimation

3.4.1 Direct financial loss

For aesthetic value, zoonotic importance and breakage of parasite's life cycle, all infected organs were condemned. Out of 768 organs inspected, 160 (83 lungs, and 77 livers) were condemned due to hydatidosis as shown below in table 4.

Table 4. Total number of organs condemned due to hydatidosis and its current price

Organ type	Rejection rate (%)	Price per organ in Birr	Total
Lung	83 (21.61)	20	1660
Liver	77 (20.05)	70	5390
Total	160 (41.7)	90	7050

The direct financial loss was calculated using the formula given:

$$LOC = (pI1xTkxc1) + (pI2xTkxc2) \quad \text{----Equ.2}$$

= (4720*21.61*20) + (4720*20.05*70) =8,664,504 ETB/313,931.3USD

The indirect financial loss was also calculated as follows

LCWL = CSR × CL × BC × P ----Equ.3

=4720*126kg*5%*190birr*33.05% =1,867,272.12 ETB/68,348.17USD

The present study has estimated an overall financial loss to be 10,531,776.12 ETB/385,496.93USD per annum. The study implied as the indirect loss was superior to direct loss.

4. DISCUSSION

The present study has provided an up dated total prevalance of bovine hydatidosis in cattle over the study areas to be 33.05%. The current report was almost in agreement with the findings of Tolossa *et al* (2009) and Feyissa (1987) who reported prevalence of 31.44% and 31.19% in Jimma and Nekemte municipal abattiors, respectively. However, the current report was relatively higher than the findings of Ayele *et al* (2016) who reported prevalence of 24.1 % and 20.05% in cattle in Debre tabor and Dire dawa municipal abattiors, respectively. Similarly, Abera *et al* (2014) and Abunna *et al* (2012) reported a prevalence of 11.3% and 12.17% in Harar and Kombolcha Elfora municipal abattiors, respectively. On the other hand, the current report was lower than the findings of Ayub (2016), Getaw *et al (*2010), kebede *et al* (2009), jobre *et al (*1996), kebede (2012) and Ernest *et al* (2008) who reported prevalence of 55.5%,46.8% , 48.9% , 46.5% , 47.2% and 48.7% in Jimma municipal abattior, in Hawassa Municipal abattoir, in Debre Markos Municipal abattoir, in Debre Zeit Municipal abattoir, in Southern region of Ethiopia and Nagorgoro district of Arusha region, Tanzania, respectively.

Variations observed in the prevalence of hydatidosis among different reporters might be attributed to strain difference of *Echinococcus granulosus* that exist in different geographical locations, the source of cattle, dog population, dog management and deworming practices, offal disposal habits, body condition score of slaughtered animals, age of the animals slaughtered and socio economic practices in different region of the country (Arbabi *et al*., 2006 and McManus, 2006).

Analytical attempt was also made to assess the existence or absence of relationship between the disease and the risk factors. Accordingly, association was assessed between animal origin and prevalence of the disease and found to be statistically insignificant (P>0.05) which was in agreement with the findings of Regassa *et al*., (2010). This could be due to difficulty in getting exact origin of the animals and exchanging of the animals in local markets. However, the present finding doesn't agree with the findings of Yetnayet (2010) who reported that the existence of statistically significant co-relation between bovine hydatidosis and origins of animals which in turn could be attributed to difference in social activity, attitudes of dogs and climatic conditions in different regions. Similarly, an attempt was also made to find the impact of body condition of animals on disease occurrence where no statistically significant association indicated between the disease and animal body condition score. The present

finding aligns with the findings reported by Regassa *et al*., (2010). However, it disagrees with the study reported by Melaku *et al* (2011) who reported that animals with poor body condition are highly infected followed by medium and good.

The current study has also pointed out the magnitude of annual financial loss due to organ condemnation and carcass weight loss as a consequence of hydatidosis to be 10,531,776.12ETB/385,496.93USD. The study revealed a relatively higher annaul loss compared to previous reports. Regassa *et al.,* 2010) reported an annual financial loss amounted at 1,791,625.89 at Hawassa municipal abattoir, 681,333.87 ETB reported by (Melaku *et al*., 2012) from Dessie Municipal abattoir and 674,093.038 ETB by (Endalew and Nuraddis, 2013) from Gondar. The differences in financial loss estimation in various abattoir studies may be due to the variations in the prevalence of the disease, mean annual number of cattle slaughtered in different abattoirs and variations in the retail market price of organs (Polydrous, 1981).

5. CONCLUSION AND RECOMMENDATION

Bovine hydatidosis could be taken as the leading cause of economic loss in meat industries in Ethiopia. The present study has provided a higher and updated status of hydatidosis prevalence in the locality chosen and could be a public health concern and has also estimated the magnitude of annual financial loss associated with the disease in that specific site of the study. The current study has revealed a higher (concerning) prevalence of bovine hydatidosis in the study districts urging prompted and collaborative actions to be set in place.

6. REFERENCES

1. Abera,T., Lemma, B.,Urga., Niguse, A., and Agonafir, A.Prevalence of Bovine Hydatidosis and Its Economic Significance in Harar Municipality Abattoir, Eastern Ethiopia College of Veterinary Medicine, Jigjiga University, Jijiga, Ethiopia American-Eurasian Journal of Scientific Research 9 (5):2014.p.143-149.
2. Abunna, F., Fentaye, S., Megerssa, B. andRegassa, A. prevalance of bovine hydatiodisis in kombolcha Elfora abattior north eastern School of Veterinary Medicine, Hawassa University, Hawassa, Ethiopia.2012.
3. Ayele, B., Tadess, A., ,Asefa, A and Haile, B.Prevalence and Economic Significance of Bovine Cystic Echinococcosis in Debra Tabor Municipal Abattoir, North West EthiopiaActaParasitologicaGlobalis 7 (3): 2016.114-120.
4. Ayub,T., Benti, D. and Mukarim, A. Study on Prevalence and Monetary Loss Attributed to Hydatidosis in Cattle Slaughtered at Jimma Municipal Abattoir, Southwestern Ethiopiaglobal journal of medical research: gveterinary science and veterinary medicineVolume 16 Issue 2 Version 1.0. 2016.
5. Bourée, P.,. Hydatidosis: dynamics oftransmission. World Journal of Surgery, 2000, 25: 4-9.
6. Cringoli, G., Rinaldi, L., Musella, V., Veneziano, V., Maurelli, P., Di Pietro, F., Frisiello M, and Di Pietro, S. Geo-referencing livestock farms as tool for studying cystic echinococcosis epidemiology in cattle and water buffaloes from southern Italy. Geospat. Health 2(1):2007.p.105-111.

7. CSA, Federal Democratic Republic of Ethiopia. Central Statistical Agency (CAS), Volume 8, report on livestock and livestock Characterics. Statistical bulletin 583 Addis Ababa Ethiopia.2016.
8. Endalew, D. and Nuradddis, I. Prevalence and Economic Importance of Hydatidosis in Cattle Slaughtered at North Gonder, Elfora Abattoir European Journal of Applied Science, **5**: 2013.p.29-35.
9. Ernest, E., Nonga, H.E, Kassuku, A.A and Kazwala, R. R. Hydatidosis of slaughtered animals in Ngorongoro district of Arusha region, Tanzania. *Tropical AnimalHealth Production,*2008.DOI 10.1007/s11250-008-9298-z.
10. FAO, http://www.fao.org/ag/againt/subjexts/heath/dieases cards/hundatid/htm/.2011.
11. Feyissa, R., Prevalence of hydatidosis inNekemte municipal slaughter house, DVM Thesis,FVM, AAU, DZ, Ethiopia.1987.
12. Jobire, Y., F. Lobagho, R., Tiruneh, A. and Dorchies, G. Hydatidosis in selected regions in Ethiopia: an assessment trial on its prevalence, economic and public health importance, Revue de MedecineVeterinaire., 147: 1996.p.797-804.
13. John D, T., William,T., William, P., Markell, A., Edward, K. and Marietta,V., The Cestodes: *Echinococcusgranulosus*, *E.multiloularis* and *E.vogeli*(Hyatid Disease)". *MarkellandVoge'sMedicalParasitology* (9th ed.). *Elsevier Health Sciences.*2006.. pp. 224
14. Kebede, N., Mekonnen, H., Wossene, A.andTilahun, G. Hydatidosis of slaughtered cattle inWolaitaSodo Abattoir, southern Ethiopia. Trop.Anim. Health Prod., 41: 2009.p.629-633.
15. Kebede, N., Tesfu, K., Getache, T. and Chandia, M.occurance of bovine hydatidosis and evalution of its risk to humans in traditional communities of souther region of Ethiopia. J. Health Dev. 26(1):2012.p.43-48.
16. Melaku , A., Lukas, B. and Bogale, B. Cyst Viability, Organ Distribution and Financial Losses due to Hydatidosis in Cattle Slaughtered at Dessie Municipal Abattoir, North-eastern Ethiopia, Vet.World.**5**(4):2012.p.213-218.
17. Oku, Y., Malgorb, R., Benavidezb, U., Crmonab, C. andKamiyac, H. Control program against hydatidosis and the decreased prevalence in Uruguay. Int. Congr. Ser. 1267.2004.p.98-104.
18. Parija, S. Medical Parasitology, Protozoa logy and Helimenthology Text and Atlas. 2nd ed. India; Chennai Medical Book Publisher.2004.p. 221-229.
19. Regassa, F., Molla, A. and Bekele, J. Study on the prevalence of cystic hydatidosis and its economic significance in cattle slaughtered at Hawassa Municipal abattoir, Ethiopia. Trop Anim Health Prod, 42: 2010.p.977–984.
20. Regassa, F., Molla, A. and Bekele, J. Study on the prevalence of cystic hydatidosis and its economic significance in cattle slaughtered at Hawassa municipal abattoir. *Trop. Anim. Hlth.Prod.* **42**: 2010.p.977-984.
21. Smyth, J.D. Procedures for testing the viability of human hydatid cysts following surgical removal, especially after chemotherapy.Transactions of theRoyal Society of Tropical Medicine and Hygiene, 20. Macpherson, S., 1985. 74: 1994. P.649-652.
22. Soulsby, E.J.L.,. Helminthes Arthropods and Protozoa of domestic Animals 7th(Edn.), .1982.p. 90.
23. Thompson, R.C. and McManus, D.P.Aetiology: parasites and life cycles. In: WHO/OIE Manual in echinococcosis in humans and animals. WHO/OIE, Paris, 2002.p. 1-226.

24. Tolosa, T., Tigre, W., Teka, G. and Dorny, P. Prevalence of bovine cysticercosis and hydatidosis in Jimma municipal abattoir, South West Ethiopia.Onderstepoort*Journal of VeterinaryResearch,* **76**:2009.p.323–32.
25. Urquhart, G., J. Duncan, L. Armour, J. Dunn and Jenning, A.,. Veterinary parasitology. 2 ed, the ,Blackwell Science, Oxford,1996.p: 120-129.
26. Yetnayet, G. Prevalence and economic significance of Bovine hydatidosis in cattle slaughtered at Gonder ELFORA abattoir, North Gondar.DVM thesis, Faculty of Veterinary Medicine, University of Gondar, Ethiopia.2010.

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Abbreviations

ILCA	International Livestock Center for Africa
CSA	Central Statistical Agency
FAO	Food and Agricultural Organization
USD	United States Dollar
ETB	Ethiopian Birr
CSR	Average slaughtered cattle per annual in the abattoir
CL	Carcass weight loss in the individual animal
BC	Average price/cost/ of 1 kg carcass at Bahir Dar town
P	Prevalence of hydatidosisat Bahir Dar municipal apattior
ACW	Annual cost from carcass weight loss
IBM	International Business Machines
SPSS	Statistical Packages for Social Sciences
P –value	Probability value

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Participation of Local People in Community Based Ecotourism (CBET) Development Project in Ethiopia, a Case of Eastern Zone of Tigray

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ABSTRACT

Ethiopia, especially Tigray region is the origin of plenty of tourism resources like Rock Hewon churches, Axum obelisk, endemic animals and different cultural heritages, then the sector is growing fast even the tourism policy highlights for active participation of local people in tourism. Yet, CBET project is the best formal mechanism for community participation from the tourism sector. Hence the objective of this study was to assess the participation of local people in CBET development in Ethiopia, in case of eastern zone of Tigray region. Cross sectional design was applied to conduct a study at the point of time and descriptive method was used to describe the nature of the problem. Total of 163 samples was participated from the target population using judgmental from non-members of CBET communities and convenient from members of CBET and tour guides. The finding showed that, there is low participation of communities especially females in the sector, High illiteracy, less knowledge of communities in the sector than the tour guides and members of CBET. Only few peoples were engaged in the CBET project. Generally the community's involvement in the sector was found low. Then the recommendation is that, communities especially female participation in the sector should be encouraged, income from the sector should be expanded by training local community in different income generating activities. Generally Assuring integration of the national, regional, local and public-private efforts towards ecotourism development is a best action to develop the sector.

Keywords: Eco-t*ourism*, Community participation, CBET Members, Tour Guides

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1. INTRODUCTION

There is a preponderance of literature and evidence which supports the notion that tourism is one of the fastest growing sectors in the world with almost $1.2 trillion worth of bookings having being made in 2016 (World Travel and Tourism Council, 2017). In this equation, it is important to consider local community participation in tourism ventures and community growth, while the environment is sustained in a win-win scenario.

In Ethiopia tourism sector was actually a pioneer on the continent and a strong competitor to a current powerhouse on the country Kenya. But today, Kenya's tourism industry attracts many more times the tourist arrivals as Ethiopia does (by almost a factor of 5 in 2007). What was true in 1960's is still true today; Ethiopia has as many attractions and a greater variety than its southern neighbor to share with tourists. It just has not been able to capitalize on its resources like Kenya has (Melaku, 2010). Despite its relative slow growth, tourism sector is growing fast and stands as the third foreign exchange earner, following coffee and oilseeds, Mann (2006).

Different types of tourism will assume different forms and functions, and how they are developed and managed will also influence the degree to which they can contribute to development. In this regard, CBET projects have become a two-edged sword for achieving natural resource conservation and improved livelihoods of host communities (Spenceley & Snyman, 2012).

At best, ecotourism projects tend to aim for the 'involvement' of local people, and at worst, ecotourism projects can ignore the issue of local participation completely. Such projects frequently fail after a relatively short period of time, Garrod (2003).

The tourism policy of Ethiopia which is endorsed in 2009 highlight some specific provisions for active participation of local people in tourism. Yet, despite this policy call for community involvement in tourism, there is still no formal mechanism for community participation. In Ethiopia in general and in Tigray, a regional state in northern Ethiopia, in particular, tourism is always complained for not benefiting the host community of local destination areas mainly in rural areas. Although some change is taking place with regard to tourism, the change is not satisfactory for local communities in Tigray. Chernet (2008).

Even though, the degree of benefit accruing to the local economy is unknown; in Ethiopia there are already small scale benefits to the community in general and the poor in particular with considerable difference between the regions and the destinations. The elites or influential people are also among the most benefited usually the tour operators and local tour guides, (Kubsa 2007). This situation leads to debate on tourism development in Ethiopia. Domination of the sector by small groups of private investors means that adverse impact on the environment and local communities have received insufficient attention, (Connell and Rugendyke 2008). However, the more that local resident's gain from tourism, the more they will be motivated to protect the area's natural and cultural heritage and support tourism activities (Liu, 2003).

Therefore community participation in tourism development can be observed from two different angles: Participation of the local community in the decision-making process and participation in the sharing of the benefits of tourism (Wijesundara & Wimalaratana, 2016). On account of the foregoing, community participation in tourism could be seen as a model of tourism development whereby local communities take an active role in the management of tourism in their communities, are empowered to take control over the entire tourism development process, and are direct beneficiaries of the resultant benefits of tourism development.

Some researchers have done studies on community based ecotourism in different parts of Ethiopia such as (Micheal, 2008; Cherinet, 2008). These researches have mainly focused on surveying potentials for community based ecotourism development and value of ecotourism for economic development. Sntayehu A. (2015) also studied on the issue of potentialities of community participation in CBET in Choke mountain northern Ethiopia. However, this study focused in one specific mountain and few people. But this study covered different tourist attraction sits such as rock hiwon churches, cultural aspects, mountains trekking etc in wide districts in the region.

This study contributed to the existed literature by assessing the CBET development which is the new and best project to upgrade the tourism industry from the perspective of the community. The use of the CBET approach is very relevant to the conservation of the tourism resources in the study area. This is because the tourism areas of Tigray region shares boundaries and owned by a large number of local communities. Therefore the objective of the study was to assess the Participation of Local People in Community Based Ecotourism (CBET) Development Project in Ethiopia, a Case of Eastern Zone of Tigray, Ethiopia. Specifically the CBET project implementation, major practices and participation of the community in CBET development was the concern of the study.

2. MATERIALS AND METHODS

This research was used cross sectional design to assess the problem and collect data at a point of time. Descriptive method was used to describe both quantitative and qualitative data's collected from both primary (collected using questionnaire, oral interview and focused group discussion) and secondary data (collected from different sources such as documents, and reports) in order to support the primary data.

The target populations of the study was the combination of communities involved on the CBET, other communities (non-members of CBET), employees (managers) and tourist guides found in different tourism sites of eastern zone of Tigray region such Hawzien, Adigrat, Wukro, Atsbi and Freweyni. Accordingly 163 participants were selected from the target populations using Yamane's (1967) sampling size determination formula.

Respondents were selected conveniently and judgmentally techniques based on respondents familiarity to the area, availability and willingness. It is commonly acceptable level as it may be also taken based on value judgment (Kothari, 1990). Finally qualitative and quantitative analysis was made using descriptive statistical techniques.

3. RESULTS AND DISCUSSION

It is true that the sample respondents for this study were 163. However the finding was analyzed using 138 respondents because the remaining 25 respondents didn't fulfill and turned back the questionnaire correctly. Here the following started by demographic profile of respondents.

3.1 Background of Respondents

Table 1. Demographic Profile of Respondents

Description		Groups			Total	Percentage
		Member of CBET	Tour guides	Other Community		
Sex of respondents	Female	13	6	8	27	20%
	Male	48	24	39	111	80%
	Total	**61**	**30**	**47**	**138**	**100%**
Age of respondents	less than 18	0	0	5	5	3.6
	19-30	6	16	14	36	26.1
	31-40	28	11	19	58	42.0
	above 40	27	3	9	39	28.3
	Total	**61**	**30**	**47**	**138**	**100.0**
Educational level of respondents	Illiterate	16	0	13	29	21.0
	Elementary / secondary school	24	5	19	48	34.8
	College	21	7	13	41	29.7
	Degree and above	0	18	2	20	14.5
	Total	**61**	**30**	**47**	**138**	**100**
Marital status of respondents	Married	51	4	41	96	**70**
	Single	10	26	6	42	**30**
	Total	**61**	**30**	**47**	**138**	**100**
Family Size	1-3	17	23	6	46	**33**
	3-5	25	7	11	43	**31**
	Above 5	19	0	30	49	**36**
	Total	**61**	**30**	**47**	**138**	**100**

Source: own survey, (2018)

The gender distribution in the above table showed females were less participated than males which account only 20%. But males were 80%. So low participation of females may leads to poor utilization of tourism resources.

About age of respondents, from the total 138 samples, 96(70%) of them were the age group for Table 1. So adult aged groups and youths were found less participants in CBET development activities. About educational level of respondents, Few of them (14.5%) were also degree and above holders and they are tour guides, but majority of them (64.5%) are college and below educated. So illiteracy and less skill may affect for CBET development.

Marital status of respondents showed most of tour guides are small aged and unmarried than the other community and CBET members.
About family size of respondents no one tour guide were found above five family sizes. But other communities and the CBET members 49(35%) have above five family size because. This indicated most tour guides have small family size than community and the members of CBET.

3.2 Practices of CBET Development in Eastern zone of Tigray

3.2.1 Local Communities Knowledge of CBET Development

CBET is a very controversial and debated term to anyone. As a result it is difficult to reach in a common consensus for the definition of it but concept. However, there are certain guiding principles of CBET focus on Environment: (Provides environmental education, Increases public Environmental consciousness, Fosters healthy attitudes and behaviors towards nature), Economic: (Contributes to lasting local economic development, Profits earned retained within local communities, Equal distribution of revenue) and socio-cultural spheres of a destination (Promotes local people's active participation, Promotes local ownership and Enhances local communities' equilibrium & Empowerment), Wall, (1997), Alexander & Whitehouse (2004).

Table 2. Knowledge of Respondents about Community Based Ecotourism

Question		Groups			Total	Percent
		Member of CBET	Tour guides	Community		
Do you know what CBET means?	yes	54	24	23	101	**73**
	no	7	6	24	37	**27**
Total		**61**	**30**	**47**	**138**	**100%**

Source own survey, (2018)

The knowledge of respondents towards the community based ecotourism development indicates comparing to the members of CBET and tour guides shown in Table 2, the non-members (community) has no knowledge about the CBET development. In line with this according to Garrod (2003), such projects which have less participation of community were frequently failed after a relatively short period of time.
According to the information gained from interview (tourism marketing expert), although the international tourism did not develop with the pace that it should have been developed, but when compared with domestic tourism, it is on a better situation both in the region in general and in the study areas in particular. The low level of domestic tourism starts from the lack of knowledge about what tourism is among the local communities. Therefore, it is important to know how the local communities understand what CBET development is.

3.2.2 Involvement of Local People in Tourism Development

Community participation can be seen as either an integral component of empowerment or as both a cause and an effect of empowerment (Perkins & et.al., 1996). The success

of any CBET activities in particular and tourism in general dominantly depends on the active participation of the local communities. The same is true for eastern Tigray tourism areas.

Table 3. Involvement of Local People in CBET Development

Question			Groups			Total	Percent
			Member of CBET	Tour guides	Community		
Does the wereda tourism office facilitate the involvement of local communities for the development of the ecotourism sector?		Yes	21	10	15	46	33
		No	40	20	32	92	67
Total			**61**	**30**	**47**	**138**	**100**
In what type of tourism activities are you (your family member) involved currently?	Guiding		6	30	4	40	29
	Supplying vehicle		53	0	0	53	38
	Employee in lodges		2	0	3	5	4
	Selling handicrafts		0	0	0	0	0
	Supplying mule		0	0	0	0	0
	Trekking		0	0	0	0	0
	Others		0	0	15	15	11
	Not participate		0	0	25	25	18
Total			**61**	**30**	**47**	**138**	**100**

Source: own survey, (2018)

As shown in Table3 indicated respondents were asked about the participation of local people in tourism activities for the development of the sector. The result shows 92 (67%) of them replied “no”, but the remaining 46(33%) said “yes”. this result has no difference in different groups. So majority of the respondents were said “no”. This implies the tourism offices in every wereda did not well participating communities in different tourism development activities.

The second point is about the type of tourism activities that the respondents or any of their family members is engaged. According to the finding out of 63 members of CBET 53 (84%) of them were engaged in supplying of vehicle. This vehicle was given from the support of the NGO’s; new millennium villages’ project. Then it is possible to say they are using only one vehicle which is provided by the NGO.

Similarly the tour guides also engaged in guiding activity only. There is no another alternative activities done by them, rather simply keeping their round to go to guide visitors. The non-member communities are also, almost out of the total 47 respondents 25 (53%) of them are said that, they never participate even any of their family was participated in any tourism activity. 15(32%) of the communities were participated in any other tourism activities like guarding to visitors, giving key and opening the visiting areas such as churches. Only few of them 4 and 3 communities were replied as their family members are engaged in guiding and employees in the lodges respectively. Generally from the sum total respondents 53 (38%) respondents were participated in supplying vehicle which is covered by the members of CBET guiding and 40(21%) from the total samples also participated in guiding activity which is covered by the tour guides. The remaining 25 (18%) and 15 (11%) respondents were said not participated

and they participated in other activities such as guiding, and locking and unlocking the key of the visiting areas and materials respectively. This finding implies the members of CBET and the tour guides were only participated in one side. But there are a lot of alternative activities that enhance income generation. The communities who are the best owners of the tourism area were not used from the tourism income. This may leads to inappropriate utilization of tourism resources.

Table 4. Source of Income of Society and Contribution of Tourism

Question		Group membership			Total	Percent
		Member of CBET	Tour guides	Community		
What is your source of income?	Involving in Tourism	6	5	0	11	8
	daily labor	5	2	4	11	8
	Trade	4	2	1	7	5
	farmer	46	2	36	84	61
	Unemployed	0	19	6	25	18
Total		**61**	**30**	**47**	**138**	**100%**
Is tourism contributing to the economic development of the village?	yes	44	22	33	99	72
	no	13	6	12	31	22
	I don't know	4	2	2	8	6
Total		**61**	**30**	**47**	**138**	**100%**
If your answer for the above question is "yes'' are the benefits fairly distributed in the village's community?	yes	27	8	15	50	37
	no	34	21	32	87	63
Total		**61**	**29**	**47**	**137**	**100%**

Source: own survey, (2018)

The above table 4 shows about the source of income of the society and the contribution of tourism to the society. The first statement is about source of income. Accordingly most of the members of CBET were farmers which indicate, 46 out of the total 61 sampled respondents which covered 75%. Only few respondents said involved in tourism (6), daily labor (5) and trade(4). Most of the tour guides, 19 out of 30 which accounts (63%) were said as they are unemployed. Only five of them have said involved on tourism. The remaining six respondents were said daily labor, trade and farmer in equal proportion. The communities have never chosen the involvement on tourism. 36 out of 47 sampled communities (that accounts 77% of them) were farmers and the remaining few are unemployed (6) and daily labor (4).

Generally 84 (61%) of the respondents were found their income is depend on farming which is covered by the members of CBET and non-member communities. 25(18%) of the respondents also replies as they are unemployed. This number is covered by the tour guides. The remaining 11 (8%) were said involved in tourism, 11 (8%) also said on daily labor and 7 (5%) were said on trade.

From this finding it is observed that most of the members of CBET and other none member communities are farmers and the tour guides are unemployed. So even if they are in tourism activity (especially members of CBET and tour guides), they are not taken as the regular job rather supplementary job. Their major income is still not from tourism. This shows the income gained from tourism is limited. This is true that they are doing only one specific activity such that supplying vehicle and guiding respectively. This creates a low income of tourism to the society.

Currently trekking activities are becoming a special concern for tourism planners with respect to its negative environmental impact. In this regard, the basic development guidance of Tigray CBET is 'high value, tourism where much number of guests was allowed to visit each sites per day. Camping of tourists in the community based ecotourism sites is not restricted.

Best environmental practices will lead to change of attitude and perception that communities have over the environment. This will gradually result change in the habit of communities. On the other hand, there is a general belief that generation of income from tourism increases the awareness of communities about the economic value of the existing natural resources. This further leads to improved conservation and protection practices. Consequently, communities develop positive thinking and practice over their household and livelihood pattern. Therefore, sampled households were asked whether they bring change concerning the use of natural resources after the coming of tourism like on housing, cooking, toilet, etc. In general, to date there is no organized trekking regulations and monitoring mechanisms supported with scientific study in the study area. In addition, code of ethics for tourists, guides and other entities is not developed.

3.3 Major Benefits of CBET Development in the Study Area

3.3.1 Socio Cultural Aspect

The main principles or elements of ecotourism are designed to maximize the social benefits of tourism while minimizing the negative ones. Unless proper management and accepted standards where the needs and preferences of all groups are respected and designed to manage the impact of visitors; the interactive process between host and guest creates benefit and impose costs over the culture of the host society. As a matter of fact, the mission statement of developing community based ecotourism in eastern zone of Tigray by TESFA say publicly ensure sustainable improvements in the livelihood of the local communities while also contributing to the protection of cultural resources which are found around that such as Meskel celebration in Adigrat, Ashenda, traditional foods like Tihlo, Giezm, and the like.

3.3.2 Economic Aspect of CBET Development

Community based ecotourism is a key in which developing nations have an opportunity to overcome poverty; the challenge in developing such programs is to create economic opportunities for local communities that incentivize the protection of local natural and cultural resources. Economic indicators included benefits and benefit-sharing within the community.

3.3.3 Tourism as a Source of Income

Running of CBET business is one means of injecting foreign currency to the country. An interest in helping to enhance living conditions and the need to protect the environment in the eastern zone were the driving force behind the running of CBET project. The central development philosophy is creating community owned and managed private sector enterprises in rural Ethiopia. For this case there are some initiations of CBET in eastern zone of Tigray which is the most rich in different tourist attractions such as rock hiwan churches and different eco trekking destinations. In this context knowledge of the communities on the overall tourism and CBET development is one clue that helps to initiate well for the sector.

The following table is one sample taken from Hawzien wereda annual report about the number of tourist inflow and income generated from them.

Table 5. Number of Tourists Flow and Income from the Sector

Number of tourists flow and monthly income in 2017/2018														
No.	Country	July	Aug	Sep.	Oct.	Nov	Dec.	Jan.	Feb	Mar	Apr	May	Total	Dollar
1.	France	443	73	352	124	290	319	150	409	316	193	24	2682	917,010
2.	Italy	150	55	153	31	83	89	88	223	75	165	15	1038	352,935
3.	Germany	163	30	115	72	93	93	82	106	89	40	16	729	244,260
4.	Spain	127	156	85	43	84	61	34	116	27	56	3	697	239,430
5.	America	81	62	71	83	254	119	42	135	117	110	8	921	314,985
6.	Britain	191	27	53	59	53	78	76	85	84	71	15	638	214,935
7.	Diaspora	223	110	49	119	43	19	26	40	57	31	7	636	217,005
8.	Others	336	41	253	31	244	120	220	170	89	90	64	1318	432,630
9.	Total	1639	553	1121	562	1101	319	238	1284	845	756	152	8,654	2,933,190

Source: Annual report of tourism office in Hawzien Wereda 2017/18.

The above Table 5 presents the number of tourist inflow in one year and income to the tourism sector. According to Ato Weldegebriel the current tourism officer of Hawzien the plan for 2017/2018 was to increase the tourist inflow to 6,400. But the result shown 8,654; which is above the plan. This is the result of good promotion activity. The total amount of dollar gained from the tourists is 2,933,190. This is calculated by 8,654 tourists can be stay an average day of 1.5 and expected to spent 230 dollar per day. When it is expressed in terms of current exchange of rate of Birr to dollar (27.79), it gives 81,513,350 birr. So this is a yearly income, equal to around 60% of the yearly budget of Hawzien wereda, i.e. 130.5 million. These shows to what extent tourism can generate income, but as per the wereda officers' interview it is still unutilized resources. As per the data collected from interview and observation, there is huge amount of money that incurred from the sector. But the main problem is still in the distribution of this much amount of money to the community. The real owners of the resources are the communities, but in terms of benefit, they didn't.

3.4 Benefit-Sharing Mechanisms

The operational definition for the term benefit sharing involves gaining an equitable dividend from revenues generated from CBET businesses and activities. The notion of

benefit sharing goes beyond one time compensation payment. It requires treating the communities that host the natural and cultural resources as legitimate partners and co-owners.

Benefit sharing is important matter in thinking about ways to sustainably develop and manage natural and cultural tourism resources, and equally important, to improve equity when allocating the benefits and costs within society. Experiences from around the world show that benefit sharing is positive from all stakeholders' perspectives. From the most governments' perspective, benefit sharing is a practical policy tool to achieve greater social inclusiveness and to balance social, economic and environmental factors in the planning, design, implementation and operation aspects. From the communities' perspective, benefit sharing increases capacity to work effectively with governments and other organizations. From the perspective of potential investors, either from the public or private sectors, the presence of an explicit policy framework and practical provisions for benefit sharing is an indicator that locally affected communities are likely to support the development. As a consequence, the investor's risk exposure is reduced and investors are more inclined to become financing partners. The interview made with one of the local communities' representative about the benefit sharing mechanisms in the tourism area has applied indicated the tourist destination areas many tourists were arrived every year. These tourists give money to the churches, monasteries, tour guides and the culture and tourism office and invest more many in the large hotels and lodges. But, the local communities do not get any money or other benefits from the tourists' arrival on the tourism area of eastern zone of Tigray. Therefore, the local communities feel disappointed with the tourists. As a result, they request the government and other concerned bodies to think the case again but still no enough solution was made.

3.5 Activities carried out to Develop CBET Project by the Tourism Office

Table 6. Yearly performance analysis of tourism in 2010 E.C and plan of 2011

No.	Activities carried out	Performance of 2010E.C	Plan for2011 E.C
1.	Creation of Job opportunities	485	650
2.	Effective Budget and material utilization	100	100
3.	Number of supervision carried out	12	12
4.	Performance Assurance of institutions and hotels	70	80
5.	Female participation	56.75	60
6.	Increase foreign tourist inflow	10,087	11,000
7.	Increase domestic tourists	6,477	7,500
8.	Initiate tourism clubs	33	43
9.	Expansion of tourism books in to libraries	2,023	2,500
10.	Documentation of new non movable tourism resources	13	5
11.	Documentation of movable resources	550	395

12.	Registering the documented tourism resources	95	100
13.	Develop the local language	125	112
14.	Increase promotional activity	4	4
15.	Write the history of traditional churches	9	10

Source: sample annual performance report of tourism sector in Hawzien wereda 2010 E.C.

As per the above Table 6 shown, the lists of activities are the most critical activities to all the communities and the performance report in general is at good track having of some limitations. From the limitation especially, the promotional activity is planned at statuesque, but must increase since it increased the number of tourists flow. Some of the limitations observed were also the report is only one year report; there is no organized previous report. As an office it was opened and started functionally no more than two year. Additionally the office has shortage of skillful and experienced employees.

4. CONCLUSION AND RECOMMENDATION

In the previous finding and discussion part the study tried to assess the participation of local people in CBET development in eastern zone of Tigray. The finding showed that there is low participation of females in tourism and tourism related activities. So low participation of females may leads to poor utilization of tourism resources. Most of the members of CBET are farmers but the tour guides are not involved in the project. This may lead to more unemployed for the youths because it is a supplementary job for farmers, but it was better to participate more unemployed youths than the farmers. Few tour guides are usually degree holders but most of the members of CBET were found illiterate. So, illiteracy is observed as a bottleneck for the development of tourism. With regard to the knowledge about the CBET development, non-members (community) have low knowledge comparing to the members of CBET and tour guides. So this low knowledge of the community was hindering to participate more in the sector. This indicates there are few individuals involved in the project. About the expansion of income from tourism, the members of CBET and the tour guides were only participated in one activity, which means there are no alternative activities that enhance income generation. The communities also not used from the tourism's income. This may leads to poor utilization of tourism resources. About the sources of income of respondents it is observed, even if they engaged in tourism activity (especially members of CBET and tour guides), they are not taken as the regular job rather supplementary job. Their major income is still from farming not from tourism. This showed that the income gained to them from tourism is limited. This is true that they are doing only one specific activity such that supplying vehicle by few groups and guiding respectively. This creates a low income of tourism to the society. According to wereda tourism officers the tourist inflow is increasing rapidly. Other practices of CBET development activities in the area understudy are emergence of Performance Assurance of institutions and hotels,

increase Female participation, Increase foreign tourist inflow, Increase domestic tourists, Initiate tourism clubs, Expansion of tourism books in to libraries, Documentation and registering of new non movable and movable resources and etc.
The interview and observation result showed that there is huge amount of money that incurred from the sector. But the main problem is still in the distribution of this much amount of money to the stake holders (community). The real owners of the resources are the communities, but in terms benefit, they are not. This is the most drawback of tourism industry. CBET development is started to reduce such problem, but the application of the reality is still at doubt.
Based on the findings and conclusion made, the following possible recommendations were forwarded so as to help to solve the problems understudy. As the first point of discussion showed about the gender difference in participation in tourism, females were fewer participants in tourism. But they are the most actors in the economy. So the tourism office in each weredas in particular and bureau of tourism and culture in general should develop new policy that helps females to engage in tourism because the tourism economy cannot develop without the involvement of females being females are the main actors in the economy. Unemployed youths should be better participants in all activities of the sector than the farmers to reduce unemployment rate and to provide good service to customers. This is because of the youths are more educated than the farmers. Hence education is the key factor for the development of CBET. With regard to the practice of CBET development in the area, awareness creation should create first to all stake holders. One of the major activities to make ecotourism as a force of change is by promoting community livelihood through intensive tourism awareness creation programs at grass root level. The communities should be aware of the advantages and disadvantages of CBE in particular. This includes the importance of preservation and conservation of heritages, participation of the community as collective groups to develop and run tourism, appraising the psychological relations of host-tourist, providing proper service and hosting tourists properly etc. As the level of usage from tourism is low, all the tour guides, members of CBET and other communities should expand different activities so as to enhance the income from the sector. Mostly the communities are not used from the sector. So government should reorganize in new fashion that involved the community. Most of the profits were taken by the hotels, lodges, and tour operators. So the real owners of the tourism site were not used from the sector. The new system which is used to share the income to the communities should create by the government. The tour guiding service must not take as the supplementary job rather it should be taken as the regular job and the best income generator job and expanded in to another similar income generating activity. Finally, providing training and graduating local community on the craft production, organization of cultural events, etc. are suggested to diversify economic participation in tourism.

Limitation for Further Study

This study focused on the Eco-tourism development practices in eastern zone of Tigray. So it focused only the limited study area, but it was better to study in Ethiopian

perspective. Furthermore, this study didn't cover the main challenges and opportunities of the CBET project, rather simply assessed the practice and way of its implementation. Finally the study didn't cover the whole community for investigation, rather simply fixed target populations. Hence a researcher who can cover those limitations can do further investigation.

5. REFERENCES

1. Alexander, S. E., & Whitehouse, J. L. (2004). Challenges for balancing conservation and development through ecotourism: Insights and implications from two Belizean case studies. In F. D. Pineda & C. A. Brebbia, Sustainable tourism. Southampton: WIT Press
2. C.R. Kothari. (1990). research methodology, methods and techniques
3. Chernet T. (2008). Community based eco-tourism development: The case of Adwa and its environs. Master thesis in development studies, environment and development. Addiss Ababa, Ethiopia
4. Connel, J. and Rugendyke B. (2008). Tourism at Grass Root Level. Villagers and Visitors in Asia Pacific. London and New York: Routledge
5. Connel, J. and Rugendyke, B. (2008). Tourism at Grass Root Level. Villagers and Visitors in Asia Pacific. London and New York: Routledge
6. Garrod, B. (2003). Local Participation in the Planning and Management of Ecotourism: A Revised Model Approach. Journal of Ecotourism, 2: 1, 33-53.
7. Hipwell, W.T. (2007). Taiwan Aboriginal Ecotourism: Tanayiku Natural Ecology Park. Annals of Tourism Research, 34 (4) 876-897.
8. Kubsa A. (2007). An Analysis of Government Incentives for Increasing the Local Economic Impacts of Tourism in Ethiopia, Tourism and Development Agendas for Action. Kenya, English Press Ltd. Longman
9. Liu, Z. (2003). Sustainable Tourism Development: A Critique. Journal of Sustainable Tourism, 11:6, 459-475.
10. Mann, S. (2006). Ethiopia, in Makeda's Footsteps: Towards a Strategy for Pro-Poor Tourism Development. World Bank report to Ethiopian Government.
11. Melaku Sahlu. (2010). Hidden Gem: Ethiopia is International Tourisms Unknown Treasure. Horizon Ethiopia, 3:4, p. 8-14.
12. Micheale Tsegay. (2008). "Community-based Ecotourism, Poverty Reduction and Sustainable Development: A Case from Tigray, Northern Ethiopia", MA thesis, Mekelle University.
13. Perkins, D.D., Brown, B.B., & Taylor, R.B. (1996). The ecology of empowerment: Predicting participation in community organization. Journal of Social Issues.
14. Sharply, J. (2009). Tourism Development and the Environment: Beyond Sustainability? London: Earth Scan
15. Sintayehu Ayalem Asres. (2015). Potentialities of Community Participation in Community-based Ecotourism Development: Perspective of Sustainable Local Development a Case of Choke Mountain, Northern Ethiopia. Journal of hotel and business management.
16. Spenceley, A., & Snyman, S. (2012). High-end ecotourism's role in assisting rural communities in reaching the millennium development goals. In K. S. Bricker, R. Black, & S. Cottrell (Eds.), Sustainable tourism and the millennium development goals: Effecting positive change (pp. 89–106). Burlington, MA: Jones & Bartlett Learning.

17. Wall, G. (1997). Is ecotourism sustainable? Environmental management.
18. Wijesundara, C. N. R., & Wimalaratana, R. W. (2016). Community participation in tourism benefits sharing Schemes of Sri Lanka: A case study of Arugam Bay Destination. Proceedings of ISER 26th International Conference, March 14th, Bangkok, Thailand
19. World Travel and Tourism Council. (2017). Travel and tourism global economic impact and issues 2017 [Online]. Available online at: http://www.wttc.org>files>regions-2017 [Accessed 11 June 2019]
20. Annual report of tourism office in Hawzien Wereda 2017/18 about tourism income

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PREVALENCE OF BOVINE SCHISTOSOMIASIS AND ITS ASSOCIATED RISK FACTORS IN AND AROUND BAHIR DAR TOWN, NORTHWEST ETHIOPIA

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ABSTRACT

A cross-sectional study was conducted from November 2017 to March 2018 in Bahir Dar and its surrounding areas, north-western Ethiopia, to determine the prevalence of bovine schistosomiasis and to identify risk factors associated with *Schistosoma* infection. Simple random sampling method was used to select the study animals and coprological examination was applied to identify *Schistosoma* eggs. Total 300 cattle were examined and 21.6% (n=65) were found positive for *Schistosoma* eggs. Cattle of different age groups were studied and significantly ($p<0.05$) differ with the age, young (12.9%), adult (24.1%) and old (27.3%). The prevalence of bovine schistosomiasis across kebeles was found different, in Sebatamit (29.8%), Kebele seven (22.8%),Adisalem (19.3%) and Kebele fourteen (18.7%). But, there was no significant ($p<0.05$) difference based on origin and sex. Animals categorized under poor body condition score has significantly ($p<0.05$) higher prevalence (32, 6%), followed by medium (20%) and good body condition (11%). The prevalence of the disease was higher in local (25.6%) than cross breed cattle (13.9%). It was also significantly ($p<0.05$) higher in extensive management system (26.4%) than semi-intensive management system (16.6%) and intensive management system (0%). This study indicated that bovine schistosomiasis is becoming one of the major cattle health problems in and around Bahir Dar. Therefore, control measures against schistosomiasis must be designed to target either parasite or snail or both.

Keywords: Bahir Dar, Bovine, Coprology, Prevalence, Schistosoma

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1. INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. However, the contribution of livestock industry to the national economy is considerably less than its tremendous potential due to a number of factors including disease, malnutrition and management problems. Parasitic diseases are major constraint in animal health and production throughout tropical and sub-tropical countries of the world (Juyal and Singal, 2011). Among the parasitic diseases in the country, trematodes are one of the major problems of cattle and other ruminants which considerably lowering the productivity and may cause death (Vercruysse and Claerebout, 2001).

Schistosomiasis is a snail borne trematode infection of man and animals in different parts of tropical and subtropical countries (Zangana *et al*., 2012). In livestock sector, it is an economically important disease caused by several *Schistosoma* species, which inhabit the vascular system of final hosts (Lefevre *et al*., 2010). Domestic animals in various tropical areas may be infected with *Schistosoma bovis* (cattle and sheep), *Schistosoma indium* (horses, cattle, goats and Indian buffaloes), *Schistosoma matheei* (sheep, South Africa), *Schistosoma suis* (swine and goats in India), *Schistosoma japonicum* (humans, cats and mammals in Asia) and *Schistosoma margrebowei* (horses, ruminants and elephants in Africa) . Among these *Schistosoma bovis* is the common cause of infection in cattle rearing especially in or near to marshy land. Egg morphology, intermediate host spectra, and definitive host-parasite relationships are the major criteria for species identification of the genus *Schistosoma* (Dwight *et al*., 2003).

Schistosomes are different from most other members of the Digenea in which the sexes are separate. Schistosomes are thin, elongated fluke, up to 2 cm long primarily parasitize in blood vessels of alimentary and bladder (Urquhart *et al*., 2003).

The geographical distribution of bovine schistosomiasis has been determined primarily by the distribution of snail (intermediate host) particularly *Bulinus* species which are important for the occurrence of disease in bovine species. *Schistosoma bovis* is a species whose final hosts are bovine, ovine, caprine and whose reservoir hosts are small wild ruminants. They are distributed throughout Africa, South West Asia and Mediterranean, Europe (Urquhart *et al*., 2003). Animal and human schistosomiasis are dependent on environmental factors such as moisture, rainfall, temperature, water bodies (stagnant ponds, swamps, streams, rivers, irrigation canals, marshes and dams) and snail (Niaz*et al*., 2010; Li *et al*., 2012).

Diagnosis is based on clinical signs and seasonal occurrence in endemic areas. But, previous history of the area or identification of snail habitats, postmortem examinations and examination of faeces for fluke eggs are the best options. However, coprological analysis is commonly used (Thrusfied, 2005). Praziquantel is a highly effective drug for the treatment of bovine schistosomiasis. Treatment of schistosomiasis helps to reverse acute or early chronic disease, prevent complications associated with chronic

infection and prevent neuro-schistosomiasis. The most effective way to control cattle schistosomiasis in endemic areas is to prevent contact between the animals and the parasite (Richer, 2003).

Few and limited studies have been carried out with regard to bovine schistosomiasis in and around Bahir Dar. However, the disease has been encountered frequently in this area of investigation. Therefore, the present study has been designed with following objectives:

i. To estimate the prevalence of bovine schistosomiasis in and around Bahir Dar.
ii. To assess the major risk factors of schistosomiasis in the study area.

2. MATERIALS AND METHODS

2.1. Study area

The study was conducted from November 2017 to April 2018 in and around Bahirdar town, Northwest Ethiopia. This town is bordered with Lake Tana and having an altitude ranging from 1600-1800 meters above sea level and has a warm humid climate with an average annual rainfall of 700 mm. The annual temperature of the area ranges from 12.40 -27°C. The landscape is marked by the presence of Lake Tana, which drains a water shed of about 3,000 km^2 and areas adjacent to Lake Tana and Abay River have poor drainage and annual over flooding during the dry months. The total number of cattle population in Western Gojjam zone was 1,800,917 (CSA, 2008).

2.2. Study population

Samples were collected from local and cross breed cattle reared in different management practices of different age group, breed, sex and place of origin were recorded in the study area. Body condition score of cattle was categorized as poor (1), moderate (2) and good (3) as per method described by Ferguson *et al*., 1994 (Annex 1). The age of cattle was estimated by teeth method, horn method and tail brush method as expressed by Cole, 2008 (Annex 2).

2.3. Sample size

The desired sample size was calculated using the formula given by Thrusfied (2005) with 95% confidence level, 5% desired absolute precision and 26.6% expected prevalence (Assefa *et al*., 2013)and 300 cattle were selected using simple random sampling method to estimate the prevalence of the disease, $n=1.96^2 (p)(1-p)/ d^2$, where, n=required sample size, 1.96= value at 95% confidence interval, p=expected prevalence of schistosomiasis and d=desired absolute precision level at 95% confidence interval (0.05).

2.4. Sample collection

Fresh fecal samples were directly collected from the rectum of the cattle and were preserved in 10% formalin in air tight condition to prevent hatching of miracidia. The eggs were concentrated through sedimentation method and observed under low power microscope.

2.5. Data analysis

Collected data was analyzed using SPSS statistics software program version 20. The total prevalence was calculated by dividing number of positive animals by total number of animas tested. Chi-square was also used for data analysis particularly to determine whether risk factors.

3. RESULT ANALYSIS

Out of 300 faecal samples, 65 (21.6%) samples were found positive for *Schistosoma* eggs. The prevalence of *Schistosoma* infection in this study in relation to origin was higher in Sebatamite (29.8%) as compared to that of kebele seven (22.8%), adisalem (19.3%) and kebele fourteen (18.7%). However, the differences were observed statistically non-significant ($p>0.05$) as shown in Table 1.

Table 1. Overall prevalence of bovine Schistosomiasis on the study areas

Origin	No. of animals examined	No. of positive cases	Prevalence (%)	Chi-square	p-value
Kebele 14	80	15	18.7	2.619	0.454
Kebele 7	83	19	22.8		
Sebatamite	44	13	29.8		
Adisalem	93	18	19.3		
Total	300	65	21.6		

The prevalence of schistosomiasis was higher in old cattle (27.3%), followed adult cattle (24.1%) and lowest in young age groups (12.9%) which differs significantly ($p<0.05$) in all the categories (Table 2).

Table 2. The prevalence of schistosomiasis based on age risk factor

Age	No of animal examined	No of positive cases	Prevalence (%)	Chi-square	p-value	Odd ratio
Young	93	12	12.9	6.41	0.041	
Adult	108	26	24.1			0.395 (0.187-0.897)
Old	99	27	27.3			0.846 (0.453-1.579)
Total	300	65	21.6			

The prevalence of schistosomiasis was significantly ($p>0.05$) highest in female (24.4%) than male (18.7%) presented in Table 3.

Table 3. The prevalence of schistosomiasis based on sex risk factor

Sex	No. of animals examined	No. of positive	Prevalence (%)	Chi-square	p-value
Male	138	26	18.7	1.868	0.43
Female	160	39	24.4		
Total	300	65	21.6		

The prevalence of bovine Schistosoma infection was significantly (p>0.05) highest in local breed cattle (25.6%) as compare to cross breed cattle (13.9%) (Table 4).

Table 4: The prevalence of schistosomiasis based on Breed risk factor

Breed	No. of animals examined	No. of positive cases	prevalence	Chi-square	p-value	Odd ratio
Local	199	51	25.6	5.465	0.013	
Cross	101	14	13.9			2.141 (1.120-4.094)
Total	300	65	21.6			

The highest prevalence of schistosomiasis was significantly (p>0.05) highest in cattle with poor body conditioned (32.6%), followed by medium body conditioned (20%) and lowest in cattle with good body conditioned (11%) (Table 5).

Table 5. The prevalence of schistosomiasis based on body condition risk factor.

Bodycondition	No.of animals examined	No.of positive	prevalence	Chi-square	p-value	Odd Ratio
Poor	92	30	32.6	11.642	0.003	
Medium	135	27	20			3.931(1.674-9.235)
Good	73	8	11			2.031(0.871-4.737)
Total	300	65	21.6			

The prevalence of bovine schistosomiasis was found significantly (p>0.05) higher in extensive management of cattle (26.6%) than that of semi intensive management cattle (16.6%), while the prevalence of *S. bovis* in intensive management was 0% (Table 6).

Table 6. The prevalence of schistosomiasis based on management system risk factor

Management	No of animals examined	No of positive	Prevalence (%)	Chi-square	p-value	Odd ratio
Extensive	208	55	26.4	12.53	0.002	
Semi intensive	60	10	16.6			0.556(0.264-1.173)
Intensive	32	0	0			0.00(0.00-.)
Total	300	65	21.6			

4. DISCUSSION

The cross-sectional study was primarily conducted to assess the prevalence of bovine schistosomiasis and investigate potential risk factors related to its occurrence. The overall prevalence of *Schistosoma bovis* was found 21.6%. This prevalence rate is relatively lower as compared to previous studies which was 37.3% (Almaz and Solomon, 2011) and 34% (Hailu, 1999) in Bahir Dar. The lower prevalence rate of schistosomiasis recorded in this study was might be due to the variation in seasons, sample size, humidity, management practice and climate change. The prevalence rate in the present study was in accordance to the findings of Solomon (2008), Addis *et al*. (2017) and Miressa and Feyissa (2017). However, the prevalence rate was higher than previous study of Mersha *et al*. (2012), Adane and Mulat (2015) andYalelet (2004). The higher prevalence of schistosomiasis recorded in this study was might be due to the greater stagnant water bodies and irrigation practice in the study kebeles, which was favorable for the development and multiplication of snail.

The prevalence rate of schistosomiasis was significantly ($p<0.05$) higher in old cattle (27.3%) than the adult cattle (24.1%), while the lowest prevalence was observed in young cattle (12.9%). This is close agreement with Mengistu *et al*. (2012) and Merawe *et al*. (2014) who stated a significant effect of age on *S. bovis* infection in animals. The present result disagrees with Alemseged (2010), who reported the prevalence rate of 17.6% in cattle below 2 years of age; 30.10% in age between 2 and 5 years and 27.80% above 5 years of age in Dembia district.

The prevalence of schistosomiasis in relation to sex was higher in female (24.4%) than males (18.7%), did not differ significantly ($p>0.05$) Similarly, Solomon (2008) reported a prevalence rate of 29.61% in female and 19.54% in male in and around Bahir Dar and Belayneh and Tadesse (2014) reported 25.9% prevalence in female and 22.4% prevalence in male in Bahir Dar.

Significantly ($p>0.05$) higher prevalence of bovine Schistosoma infection was observed in local (25.6%) as compare to cross breed cattle (13.9%). This result are in agreement with the findings of Belayneh and Tadesse (2014) who reported higher prevalence (24.5%) in local breed cattle than that of cross breed cattle (18.6%) and disagreed with the observations of Mihret and Samuel (2015) who reported the higher prevalence rate in cross breed (8.3%) than that of local breed cattle (7.2%). This might be associated with the difference in exposure to natural infection. The cross breed cattle reared for milk purpose was kept in semi-intensive management system and hence exposure to infection less as compared to local cattle reared in extensive management system pickup more infection naturally. The statistical analysis of this study showed that body condition score of the animals had significant ($p<0.05$) influence on the prevalence of bovine schistosomiasis. The highest prevalence was observed in animals with poor body condition (32.6%), followed by medium body condition (20%) and lowest in cattle with good body condition (11%). This Result was similar to the result of Miressa and Feyissa (2017) who reported the prevalence rate of 32.46% in animals of poor body condition score, 21.42% in medium body condition score and 11.86% in good body condition score. Abebe *et al*. (2011) also reported that the prevalence of

schistosomiasis was 23.81% in animals of poor body condition score, 3.92% in medium body condition score and 0.00% in good body condition score in Jimma and Agaro area. The deviation might be due to variation in the accessibility of animals to the marshy area and management. However, non-significantly ($p<0.05$) highest *Schistosoma* infection was observed in sebatamit kebele (29.8%) as compared to those found in kebele seven (22.8%), adisalem (19.3%) and kebele seventeen (18.7%). This result agrees with the findings of Meriem and Tewodros (2015) in fogera wereda and disagrees with the result of Miressa and Feyissa (2017) in bakko town. The variation observed in the infection rate of the disease among the different kebeles might be attributed to the differences in the degree of swampiness (marshy-stagnant water), the number of rivers flowing in the area and the moisture content.

4. CONCLUSION AND RECOMMENDATION

The higher (21.6%) prevalence of *Schistosoma* infection can causes a significant economic loss to the local community. Schistosomiasis should be taken in to consideration as one of the major limiting factor of livestock production. The sub-clinical nature of the disease causes long term effect on animal growth and productivity and increase susceptibility to other parasitic or bacterial infections. The occurrence of schistosomiasis is closely linked with environmental factors suitable for the development, breeding and multiplication of intermediate host (snail) and the parasite itself. Risk factors such as age, breed, and body condition score and management had significant effect on prevalence rate of schistosomiasis in cattle, but sex and origin did not show any significant effect. Moreover, the study area is suitable for the survival of the snail, which further worsened the situation. In view of above conclusion the following recommendations can be adopted in the area of investigation to prevent *Schistosoma* infection in cattle.

- Farmers should avoid their cattle to graze freely in swampy area and supply dry feeds.
- Regular deworming before and after rainy season.
- Farmers should aware with the risk factors of *Schistosoma* infection.
- Strategic control measures against schistosomiasis must be designed to target either the parasite or the intermediate host snail.

5. REFERENCES

1. Abebe, F.,Behablom, M. and Berhanu, M. (2011): Major trematode infections of cattle slaughtered at Jimma municipality abattoir and the occurrence of the intermediate hosts in selected water bodies of the zone. *Journal of Animal and Veterinary Advances*, **10** (2): 1592-1597.
2. Adane, A. and Mulat, A. (2015): Cross-sectional Study on Prevalence of Bovine Schistosomiosis and its Associated Risk Factors in Dangila District, Amhara National Regional State, Ethiopia. *Journal of Animal Research*, **5**(3): 397-402.
3. Addis, K., Solomon, T. and Shewangzaw, A. (2017): Prevalence and Associated Risk Factors of Bovine Schistosomiasis in Northwestern Ethiopia. *World Vet J*, **7**(1): 01-04.

4. Alemseged, G. (2010): Prevalence of bovine schistosomiasis in Dembia District North west Ethiopia. Dvm thesis, faculty of veterinary medicine. Gondar, Ethiopia.
5. Almaz, H. and Solomon,W. (2011): Repeated simple sedimentation and prevalence of bovine schistosomiasis in selected area of Bahir Dar. *Ethiopian Veterinary Journal*, **15**(1): 49-57.
6. Assefa, D., Gashaw, G. and Tesfa, M. (2013): Coproscopic prevalence of major trematode infections of cattle in and around Bahirdar, University of Gondar, Faculty of Veterinary Medicine, Department of Biomedical Science, Gondar, Ethiopia.
7. Belayneh, L. and Tadesse G. (2014): Bovine Schistosomiasis: A Threat in Public Health Perspective in Bahir Dar Town, Northwest Ethiopia. *Acta Parasitologica Globalis*, **5** (1): 01-06
8. CSA (Central Statistical Agency). (2008): Ethiopian Agricultural Sample Survey, diagnosis of bovine fasciolosis. *Veterinary Parasitology*, **105**: 337-343.
9. Dwight, D., Bowman, I. and George, A. (2003): Parasitology for Veterinarians. 1 ed. USA: Elsevier pp: 129-133.
10. Hailu, M. (1999): Observations on the prevalence and intensity of schistosoma infection in Bahir Dar area, North West Ethiopia. DVM Thesis Faculty of Veterinary Medicine, Addis Ababa University Debre Zeit, Ethiopia.
11. Juyal, P. and Singal, L. (2011): Herbal immunomodulatory and therapeutic approaches to control parasitic infection in livestock. Department of Veterinary Parasitology, College of Veterinary Scie,nce Punjab Agricultural University Ludhiana-1441004, India, Pp 1-8.
12. Lefevre, C., Blancou, J., Chermette, R. and Uilenberg, G.(2010): Infectious disease of livestock.1 ed. Paris. Lavoizer, 2: 1699-1703.
13. Li S., Qian, Y. and Yang, K. (2012): Successful outcome of an integrated strategy for the reduction of schistosomiasis transmission in an endemically complex area. *Geosp Hlth*, **6**: 215-220.
14. Marquardt, C. and Greive, B. (2000): Parasitology and vector biology. 2nd ed. Sandiago: Harcourt acadamic press. p. 265-272.
15. Mersha, C., Belay, D. and Tewodros, F. (2012): Prevalence of Cattle schistosomiasis and Associated Risk Factors in Fogera Cattle, South Gondar Zone and Amhara National Regional State, Ethiopia. *Journal of Advanced Veterinary Research*, **2**: 53-56.
16. Meriem, E. and Tewodros, A. (2015): Study on the Prevalence of Bovine Schistosomiasis in FogeraWoreda, North-West of Ethiopia. *European Journal of Biological Sciences*, 7(4): 186-190.
17. Mihret, T. and Samuel, D. (2015): prevalence of Bovine Schistosomiasis and its Associated Risk Factor in and Around Debre Tabor Town, North West of Ethiopia Department of Veterinary Clinical Medicine, Faculty of Veterinary Medicine, *European Journal of Biological Sciences*, **7**(3): 108-113.
18. Miressa, B. and Feyissa, B. (2017): Prevalence and Associated Risk Factors of Bovine Schistosomiasis in and Around Bakko Town, west Shoa Zone, Oromia, Ethiopia. *Global Journal of Science Frontier Research: D Agriculture and Veterinary*, **7**(1) :1.0.
19. Niaz, S., Tanveer, A. and Qureshi, A. (2010): Prevalence of schistosomiasis in cows and buffaloes at different sites of Punjab, Pakistan and its relation to temperature, relative humidity, rainfall and Pan Evaporation. *Pak Journal Science*, **62**: 242-249.

20. Richer (2003): The impact of chemotherapy on morbidity due to schistosomiasis. *Acta trop*, **86:** 2-3.
21. Samrawit, M. and Mulat, A. (2016): Study on prevalence and associated risk factors of bovine schistosomiasis in Bahir Dar and its surrounding areas international. *Journal of Veterinary Science and Animal Husbundary*, **1**(3): 01-07.
22. Solomon, O. (2008): Observations on the prevalence of *Schistosoma bovis* infection in Bahir Dar area. North central Ethiopia. DVM Thesis, Faculty of veterinary Medicine, Mekele University Ethiopia.
23. Solomon, O. (2008): Observation on the prevalence of schistosomaBovis infection in Bahir Dar area, North central Ethiopia, *Global Veterinaria*, **3**(1): 13-16.
24. Thrusfied, M. (2005): Survey in veterinary epidemiology 2 ed. Cambridge: Blackwell science
25. Tilahun, H. and Schmidt, E. (2012): Spatial Analysis of Livestock Production Patterns in Ethiopia.ESSP II Working Paper 44. Addis Ababa, Ethiopia: International Food Policy Research Institute/Ethiopia Strategy Support Program II.
26. Urguhart, G, Almour, J, Duncan, J., Dunn, A. and Jennings, F. (2003): Veterinary parasitology. 2nd ed.Scotland. Black well science, **277**:117-120.
27. Vercruysse, J. and Claerebout, E. (2001): Treatment vs. non-treatment of helminths infections in cattle: Defining the threshold. *Veterinary Parasitology*, **98**: 195-214.
28. Yalelet, W. (2004): Survey on Bovine Schistosomosis in and around Bahir Dar, Northwest Ethiopia, DVM Thesis Faculty of veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
29. Zangana, I. and Aziz,K. (2012): Prevalence and pathological study of schistosomiasis in sheep in Akra/Dohuk province, Norther Iraq. *Iraq Journal of Zangana, I. and K. Aziz.Prevalance and Journal of Advanced Veterinary Research*, **2**: 53-56.

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Analysis of Urban Households' Food Insecurity in Eastern Zone of Tigray Regional State, Ethiopia

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ABSTRACT

The purpose of this study is to assess the incidence, extent and determinants of food insecurity among urban households in the major towns of Eastern zone of Tigray, Ethiopia, namely Adigrat and Wukro. Data for the study is obtained from 397 randomly selected urban households using structured questionnaire. FGT index and binary logit model are used for data analysis. The finding from FGT index shows that 7.4% and 5.4% of households in Adigrat and Wukro are food insecure, respectively. The depth and severity of food insecurity is 2.1% and 0.1% in Adigrat, and 1.5% and 0.5% in Wukro, respectively. The logistic regression model result reveals that variables such as family size, age of the household head, education status of the household head and credit access are significant factors influencing urban households' food insecurity in the major towns of the zone at less than 10 % significance level.

Keywords: FGT index, logit model, urban households, food insecurity, Eastern zone of Tigray.

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1. INTRODUCTION

With an estimated 795 million of the global population reported to be undernourished, the food insecurity concept is the most widely misunderstood and controversial measurement in the current global discourse of welfare analysis and human development (Allen, 2013; Pinstrup-Andersen, 2009). Food security has been declared a human right as early as the 1948 Universal Declaration of Human rights and is also enshrined in the 1966 International Convention of Socio-economic and Cultural rights (UNOHCR, 2006). Despite the protection of this right in both regional and national constitutions, the challenge of addressing food insecurity continues to be a policy challenge in most developing countries. This is evidenced by the clarion call to eradicate hunger and extreme poverty as part of the 2030 global sustainable development agenda (UN, 2015). On a similar note, given the nascent challenges of rural to urban migration and increased urban influx, food insecurity is no longer considered an exclusive rural phenomenon: it has also migrated to cities (Zezza and Tasciotti, 2010).

Urbanization has been supported by the rapid growth in the World economy and in the proportion of gross World product and of workers in industrial and service enterprises. Globally, agriculture has met the demands from this rapidly growing urban population, including food. But, hundreds of millions of urban residents suffer under-nutrition (Satterthwaite et al., 2010).

The dramatic growth of towns in the developing World has brought with it a new challenge - widespread and increasing urban poverty. However, efforts to address the unique problems of urban poverty lag far behind the growth of the problems themselves. Antipoverty initiatives have traditionally targeted rural areas, which were presumed to have been worse off than urban areas. But, the problems of poor town dwellers have become more pressing including the issues of how the urban poor earn their livelihood and the ways in which this affects key indicators of human welfare, such as food security and nutrition (Maxwell et al., 2000).

Urban populations in Africa are growing rapidly, and inequality is increasing. The major urban food problems of the 1970s and 1980s, food shortage and price shocks, have apparently been largely resolved at least in the short to medium term. Because of this urban food security having long been defined as the issue of feeding the towns has dropped off the political agenda of urban planners and managers; indeed specifically urban food security problems receives relatively little attention from the national food or nutritional policy planners. Urban food security problems in Africa receive little attention partly because it tends not to be linked to seasonal or community wide process and partly because of a long–held belief that urban populations are better off but urban food insecurity is directly linked to urban poverty and inequality and for this reason research on urban food security must focus on the question of access to food (Mitlin, 2012).

Ethiopia's current urban population is about 17 million (16.5% of the country's total population). Compared to other African countries, Ethiopia's level of urbanization is

low. However, the urban population is increasing rapidly with an average growth rate of 4% per year. This population growth rate will probably result in Ethiopia's urban population exceeding 60 million by 2050 (CSA, 2018).

An increasing trend of the share of the poor population in urban areas, high inequalities in income distribution, high population growth rates, high food prices and low job creation all combine to threaten the food security of the urban poor. This presents a new challenge to policy makers of balancing their efforts to address not only rural poverty but also urban poverty. More importantly the issues of urban poverty such as food and nutrition insecurity need attention (Ssewanyana, 2003).

While there is a need for understanding food insecurity in an increasingly urbanizing Ethiopia in general and Tigray in particular, little attention has been paid to urban households. The major towns of Eastern zone of Tigray are not an exception. Further, despite a large number of studies on food insecurity, it is surprising that food insecurity is most often studied as a rural phenomenon. Only few research works such as those by (Gebre, 2012) and (Feleke and Bogale, 2009) are available on urban food insecurity in the country up to now. Hence this research work mainly focuses on the dimensions and determinants of urban households' food insecurity in Adigrat and Wukro.

2. LITERATURE REVIEW

A number of studies have been conducted to measure urban household food insecurity in different context (Craig and Scanlan, 2002; Gani and Prasad, 2007; Vasco, 2006, among others). The study conducted by Feleke and Bogale (2009) using Foster-Greer-Thorbecke (FGT) model shows that 43% of households in Dire Dawa fail to meet the daily recommended caloric requirement, 13% are also far from recommended caloric intake set by the government of Ethiopia on average and 5.9 % under severe food insecurity condition. On the other hand, the study by Muche *et al*. (2014) using the same model demonstrates that 42.9% are living below minimum requirement; 4.4% are far from minimum requirement; and 0.4% are under severe food insecurity situation in Mana woreda of Jimma zone, Southwest Ethiopia.

According to Zerihun and Getachew (2012), the absolute head count index, the normalized calorie deficiency gap index and the square calorie deficiency gap in Mareko woreda, Guraghe zone, Southern Ethiopia are about 60%, 5.8% and 1.8%, respectively. Whereas, a study by Gebre (2012) reveals that the incidence, depth and severity of food insecurity are 58%, 20% and 9.4% in Addis Abeba, respectively. In addition to this, the study conducted by Mitiku and Legesse (2014) report that 42% of the sampled households are not able to meet the daily recommended caloric requirement; 14.67% of food insecure households are far from the recommended daily caloric requirement level and 7.26% of households are the most food insecure groups of households in Jimma zone, Southwestern Ethiopia.

A study conducted in South Africa (Cape Town, Msunduzi and Johannesburg) by Frayne *et.al* (2009) indicates urban food insecurity is experienced at the levels of the household and individual. While aggregate food supplies may be sufficient at the

metropolitan scale, access to that food is highly inequitable in South African cities, with many households chronically hungry.

Another study by Ashimogo and Hella (2000) in Iringa, Tanzania show that household food security is positively influenced by total household asset disposal and income. On the other hand, the study shows that the transition to commercial agriculture has had negative influence on food security. Bergeron (2002), using a situational analysis, reveals although urban agriculture is common in cities, food access for urban household depends more on households' purchasing capacity than on their agricultural production in Madagascar - although the latter remains important. Purchasing capacity is determined by prices and by income levels.

Urban livelihoods and food and nutrition security in Accra, Ghana indicates that household food availability is a function of food prices, household demographics and household tastes and preferences (Maxwell *et al.,* 2000). The result of this study shows that increase in per capita income is associated with higher household calorie availability. Households with relatively high numbers of school aged children and men of prime working age have lower food availability and calorie availability is higher in female-headed households.

The study by Feleke and Bogale (2009) in Dire Dawa, using binary logit model, shows out of nine explanatory variables, seven are found to be statistically significant. These variables include family size, daily income per adult equivalent, educational level, sex, marital status, access to credit and proportion of food expenditure where by 43% of sample households are food insecure.

Though the above reviewed empirical literatures have investigated the incidence, extent and determinants of household food insecurity, frameworks of analysis have been dominantly rural-oriented especially in Ethiopia. Literature reveals that most of the studies are more focused on the poor subsistence rural households despite increased urbanization challenges of the 21st century. Therefore, given this paucity of literature, a study that looks at the incidence, extent and determinants of urban household food insecurity in the two major towns of Eastern zone of Tigray, Ethiopia, namely Adigrat and Wukro is necessary.

3. MATERIALS AND METHODS

3.1. Description of the study area

Tigray region is one of nine regional states of Ethiopia located at latitudes from 12014'50.50" to 14053'48.03'' and longitudes from 36026'48.74" to 390 59'0.09". Tigray region is the homeland of Tigray, Erob and Kunama people. The state of Tigray shares common borders with Eritrea in the North, the State of Afar in the East, the State of Amhara in the South, and the Republic of Sudan in the West. The region is divided into 7 zones, 53 woredas (districts) and 814 tabias (sub-districts). The state's population size was 5,247,005 with an estimated area of 54,593 square kilometers (CSA, 2016/17). Most (73%) of the population live in rural, while 27% are urban dwellers. In terms of religion, 95.5% of the population are Orthodox Christians, 4.1% and 0.4% are Muslims

and Catholics, respectively. Regarding ethnic composition, 94.98% are Tigraway, 2.6% Amhara, 0.7% Erob and 0.05% Kunama. Tigrigna is the working language of the state. About 83% of the population is farmer. Teff, wheat, and barely are the main crops. Other agricultural products include beans, lentils, onions, and potatoes. Irrigation and terrace farming are used on the steep slopes. The region is also known for its export items of cotton, incense, sesame and minerals.

This research is conducted in one of the zones of the region, Eastern zone of Tigray. The zone is bordered on the East by the Afar region, on the South by South Eastern zone, on the West by Central zone and on the North by Eritrea. It covers about 13,268.99 km^2 and is divided into nine districts, including Adigrat and Wukro. The districts do vary in biophysical conditions including agro-ecological zoning, elevation, rainfall pattern and amount, temperature, land use and soil types. Most of the districts are categorized as *Dry Dega* (the highlands of Atsbi-Womberta, Ganta Afeshum, Tsaesie Tsaeda Emba), followed by Dry Weinad*ega* which covers most of the Kilte Awlaelo district. The elevation of the districts ranges from 946 to 3,298masl. Annual rainfall is variable within a range of 420-689mm. Temperature ranges from 12°C to 24°C. Most of the lands are cultivated with some patchy grazing bottomlands and hilly sites. The major soil types in the zone include Lithic Leptosols followed by Haplic Lixisols and Vertic Cambisols, respectively. The total population of the zone is 917,000 (CSA, 2018). Adigrat and Wukro are the two major towns of the zone.

3.2. Data types, sources and methods of data collection

Primary data is collected and utilized so as to achieve objectives of the study. In this regard, qualitative and quantitative data pertaining to food insecurity aspects of urban households in the study area is gathered. The main instrument used for primary data collection is well-structured questionnaire administered by the researcher and trained enumerators. The questions are prepared in English and translated into Tigrigna local language.

3.3.Sampling technique and sample size

A multistage sampling technique is employed to select sample households. Firstly, based on purposive sampling technique, the two major towns of the zone, namely Adigrat and Wukro are selected. Secondly, kebeles are selected using simple random sampling from each of the two major towns of the zone and finally systematic random sampling method are employed to select sample households from selected kebeles. We select 2 kebeles from Wukro and 3 kebeles from Adigrat. The total sample size to each selected kebeles is allocated using proportion to the size of population (PSP). The lists of households are obtained from kebele administration office.

We use Yamane (1967) formula ($n = \frac{N}{1+Ne^2}$) to determine sample size from the total population for our study in which "n" is the sample size needed, N is the population size and "e" is the margin of error. There are 28,896 households in Adigrat and 15,176 households in Wukro town (BoFED, 2018). Hence, the total population

size for the study is 28,896 + 15,176 = 44,072 households. We consider the margin error (e) for the study to be 5%. Therefore, the calculation is

$$n = \frac{44072}{1+44072(0.05^2)} = \text{around 397 samples}$$

Therefore, a total of 397 sample households are selected proportionally from the two major towns. Accordingly, these are 260 households from Adigrat and the remaining 137 households from Wukro.

3.4. Incidence and extent of food insecurity: Foster-Greer-Thorbecke (FGT) model

Household caloric acquisition is employed to measure food insecurity in this study. This method estimates the number of calories available for consumption by adult equivalent household members over a defined period of time. A popular practical method of setting food insecurity line using this method proceeds by computing the consumption level of volume of food items commonly consumed by households; then converting all quantities into kilogram/liter to have a common unit of measurement; and finally converting these quantities into kilo calories (Kcal) using Ethiopian Health and Nutrition Research Institute (EHNRI) (1998) food composition table for use in Ethiopia. Later, the converted data is divided into household Adult Equivalent (AE). Following this, it is converted to Kcal/Day basis and makes it ready to calculate Kcal/Day/AE. Daily per capita calorie consumption is estimated by dividing the estimated daily calorie supply to the household by the household size adjusted for adult equivalence using the equivalent scale weights. The 2200 kilo calorie per adult equivalent per day is used in line with the official practice used by the Ministry of Finance and Economic Cooperation earlier and now by the National Planning Commission. Accordingly, households with per capita energy intake less than the standard per capita requirement of 2,200 kilo calories are considered as food insecure and above this threshold are considered as food secure.

The next step involves estimation of the incidence and extent of food insecurity. One possible food insecurity incidence, depth and severity measurement tool, according to Hoddinott (2001), is the procedure of Foster et al. (1984) which is widely used for poverty measurement studies. Adopting this, the study measures the extent of household food insecurity. The Foster-Greer-Thorbecke (FGT) measure is given as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\left[\frac{(Z-Y_i)}{Z}\right]^\alpha \qquad \text{----Equ.1}$$

Where: N is the total sample size;

Y_i is the measure of per adult equivalent food calorie intake of the i^{th} household;

Z represents the minimum requirements per day per adult equivalent (2200 kcal/day/AE).

q is the number of food-insecure households; and

α is "food insecurity aversion" parameter (the weight attached to the severity of the food insecure).

In FGT index, if $Y_i \geq Z$ that the specified household is food secure and if $Y_i < Z$, the specified household is food insecure.

If α=0 then, FGT measure corresponds to the head count index (incidence of food insecurity) in which no concern for the depth of the shortfall is shown. The food insecurity gap, FGT (α = 1), measures how far the food insecurity of households, on average, are below subsistence level of energy. If α=2 then, FGT measures the severity of food insecurity. It takes into account not only the distance separating the food insecure from food insecurity line, but also inequality among the food insecure households.

3.5.Econometric Model Specification

To give answer to the determinants of urban households' food insecurity in Eastern zone of Tigray, logit regression model is used for this study. For the purpose of this study, the dependent variable y is defined to indicate whether a household is food insecure or not. In this case, we can let y=1 denote a household is food insecure and y=0, otherwise. Food security status of a household is identified by comparing total kilocalorie consumed in a household per adult equivalent per day with daily minimum requirement of 2200kcal and those getting less of this amount are food insecure and food secured otherwise.

Following Gujarati (2004), the functional form of cumulative logit model is specified as follows:

$$P(y_i=1) = \frac{e^{\alpha+\beta x_i}}{1+e^{\alpha+\beta x_i}} \quad \text{----Equ.2}$$

where Y_i is ith observation response that has two outcomes (food insecure as 1 and 0 otherwise), X_i's are factors that affect food insecurity, α is a constant term and β's are the coefficient of the variables (vector of parameters to be estimated).

$$1\text{-}P(y_i=1) = \frac{1}{1+e^{\alpha+\beta x_i}} \quad \text{----Equ.3}$$

$$\frac{P(y_i=1)}{1-P(y_i=1)} = e^{\alpha+\beta X_i} \quad \text{-----Equ.4}$$

Hence, $\frac{P(y_i=1)}{1-P(y_i=1)}$ is then the odds ratio of food insecure households.

Finally, by taking the natural log of equation (03) it can be obtained:

$$\ln \frac{P(y_i=1)}{1-P(y_i=1)} = \alpha + \beta X_i \quad \text{----Equ.5}$$

If the disturbance term (U_i) is introduced, the logit regression model becomes

$\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n + U_i$ ----Equ.6

3.6.Description of Variables and their Expected Signs

Table1. Variables and Expected Signs

Description of Variables	Measurement of Variables	Expected Sign
Household Food insecurity	Food insecure= 1, Food secure = 0.	Dependent Variable
Family size	Continuous	Positive
Sex of household head	1 if household head is male; 0 otherwise.	Not clear
Age of household head	Continuous	Not clear
Education level of household head	1 if household head is literate; 0 otherwise.	Negative
Remittance	1 if household got remittance; 0 otherwise.	Negative
Credit access	1 if household got credit, 0 otherwise.	Negative

Family size: An increase in household size implies more mouth to be fed from the limited resources and especially in males dominant household the situation becomes more than this due to high possibility of accustoming to bad habits. As can be mentioned by Bogale and Shimeles (2009), the household size and status of food insecurity is expected to be related positively.

Sex of household head: There is no generally accepted relationship between sex of household head and level of food security. While some argued that a household headed by a female is more likely to be food insecure compared to male headed households and others disagrees with this argument and found the opposite result.

Age of household head: Some argues older household heads are less productive and they lead their life by remittance and gifts. On the other hand, others claim household heads become more experienced with age and acquire more knowledge and physical assets, and this may affect food security in a positive way.

Education level of household head: We expect literate households to be less food insecure. The possible explanation is that household head education largely contributes to working efficiency, competency, diversify income, adopting technologies and becoming visionary in creating conducive environment to educate dependents with long term target to ensure better living condition. This is due to educated household head plays a significant role in shaping household members (Bogale and Shimeles, 2012).

Remittance: We anticipate an increase in remittance to have a positive effect because the change in income will lead to a constant change in expenditure. Thus, the income received from remittance and gifts increases the total income so that capacity of the households to consume more will increase (Gazuma, 2018).

Access to credit: As in (Gebre, 2012), we expect that those households who are willing to participate in credit scheme and manage to earn higher amount became capable to improve their income position through performing different activities. Credit serves as a means to be involved in income generating activities and to reap derived benefit based on the amount and purpose of credit. It also normalizes consumption at hard time.

3. RESULT ANALYSIS & DISCUSSION

The FGT indices namely head count ratio, depth (short-fall) and severity of food insecurity are used to show how much the magnitude of food insecurity looks like in the study areas. Based on the food insecurity threshold point, 26 sample households (6.6%) are found to be unable to meet their minimum subsistence requirement while 371 households (93.5%) are found to meet their minimum subsistence requirement.

Table 2. Food insecurity measures by FGT indices

Variables	Total Food Insecurity			
	Index		Standard error	
	Adigrat	Wukro	Adigrat	Wukro
Head count ratio	7.4%	5.4%	0.017	0.017
Food insecurity gap	2.1%	1.5%	0.006	0.005
Food insecurity severity	0.1%	0.5%	0.004	0.002

Table 2 show that the headcount ratio, depth and severity of food insecurity are 6.7%, 1.5% and 0.4% in Adigrat and 5.3%, 1.2% and 0.5% in Wukro, respectively. This implies 6.7%, in Adigrat and 5.3% in Wukro of the sampled households cannot meet the energy requirement recommended for subsistence. Each food insecure household in Adigrat needs 1.5% of the daily caloric requirement to bring them up to the recommended daily caloric requirement level besides their per capita income while it is 1.2% in Wukro. The relative deficiency among food insecure households is 0.4% in Adigrat and 0.5% in Wukro.

The estimated value of head count, food insecurity gap (short fall) and severity of food insecurity by socio-economic characteristics of household is also analyzed for both major towns of the zone. Table 2 shows that food insecurity are more severe in the large size household with food insecurity headcount index, short-fall index and severity as 8.1%, 2.6% and 1.7%, respectively. This fact indicates that food insecurity worsen as household size increased. Food insecurity is high for age group of older than 45 years with food insecurity headcount index, short-fall index and severity of 9.3%, 2.6% and 0.7%, respectively. This implies that incidence of food insecurity increased with age of household head in the study area and/or the elder head households live great deprivation than younger head households.

Food insecurity is worse in female headed household with food insecurity headcount index, short-fall index and severity of 7.4%, 2.1% and 1.02%, respectively, than the male counterpart of 5.7%, 1.5% and 0.5%. This implies that males are to some extent more engaged in income generating activities than females in the study area. The food insecurity is concentrated in the group with illiterate having an estimated headcount

ratio, short-fall index and severity of 8.05%, 2.3% and 1.12%, respectively. This analysis implies that illiterate households are more food insecure than literate ones since literate households are diversifying as well as increasing their means of income in order to drag out of food insecurity situation and lead quality life.

High indices of food insecurity are recorded for households with no opportunity of remittance than those who have an opportunity to remittance. The estimated food insecurity headcount ratio, short-fall and severity for households with no opportunity of remittance are 9.3%, 3.6% and 2.3%, respectively. The food insecurity are more severe in the group with no access to credit service having an estimated headcount ratio, short-fall index and severity of 7.6%, 2.8% and 1.2%, respectively. This indicates that households with access to credit are less food insecure than no access ones.

Table 3. Estimated indices of food insecurity for both towns by socio economic characteristics of household.

Variables	Head count index	Short-fall index	Severity index
Family size			
Small (1-4)	0.05	0.01	0.01
Medium (5-7)	0.07	0.01	0.005
Large (>8)	0.08	0.02	0.01
HH head age			
<25	0.06	0.02	0.007
26-45	0.03	0.01	0.008
>46	0.09	0.02	0.007
HH head sex			
Male	0.05	0.01	0.005
Female	0.07	0.02	0.01
HH head education			
Literate	0.04	0.01	0.004
Illiterate	0.08	0.02	0.01
Remittance			
Got remittance	0.05	0.01	0.004
Not got remittance	0.09	0.03	0.02
Access to credit			
Credit access	0.04	0.01	0.004
Without credit access	0.07	0.02	0.01

As to the determinants of food insecurity**,** the result of the logistic regression model estimate shows that out of the 6 variables, 4 variables are found to have a significant influence on the probability of being food insecure. These variables include family size, age of the household head, education of the household head, and access to credit service. That means the odds ratio of family size, age of the house hold head and education of the household head are statistically significant at 5% probability level of significance whereas access to credit service are statistically significant at 10% probability level of significance. The coefficients of 2 explanatory variables, namely sex of the household and remittance are not statistically different from zero at the

conventional levels of significance. The result obtained from the binary logit model is presented in Table 4.

Table 4. Binary logit odds ratio for determinants of food insecurity

Variables	Odds ratio	Standard Error	p-value
Family size	1.476964	0.1312133	0.043**
Sex of household head	1.027046	0.0148334	0.465
Age of household head	1.38539	0.6716414	0.021**
Education level of household head	0.7460824	0.3401497	0.032**
Remittance	1.467157	0.6738253	0.804
Credit access	0.96779	0.4367123	0.062*

* Significant at 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

In light of the above summarized model results, possible explanations for each significant independent variable are also given consecutively as follows:

Family size: This variable is found to be positively related with food insecurity and statistically significant at 5% probability level. This indicates that larger household size tends to be food insecure compared to smaller family size in the study areas. This fully agrees with prior expectation. The odds ratio of family size reveals that the probability of being food insecure will increase by approximately 1.47 with one additional family member in adult equivalent.

Age of household head: This variable affects food insecurity status positively and significantly at 5% probability level in the study areas. The positive relationship implies that older age household heads have better chance to be food insecure than younger ones. This is possible because older household heads are less productive and they lead their life by remittance and gifts. They could not participate in other income generating activities. On the other hand, older households have large number of families and their resources are distributed among their members. The odds ratio of age of household head indicates that the probability of being food insecure will increase by approximately 1.38 when age of the household increases by one year.

***Education level of household head*:** This variable affects food insecurity situation negatively and significantly at 5% probability level. The negative relationship indicates that literate households are less food insecure than illiterate households. The possible explanation is that household head education largely contributes on working efficiency, competency, diversify income, adopting technologies and becoming visionary in creating conducive environment to educate dependents with long term target to ensure better living condition than illiterate ones. This is due to educated household head plays a significant role in shaping household members. Thus, being literate reduces the chance of becoming food insecure in the sample households. The odds ratio of the

variable reveals that for literate households the probability of being food insecure decreased by 0.75.

Credit access: The sign of the coefficient of this variable shows a negative relationship with food insecurity and is significant at 10% probability level. The negative relationship implies that households with access to credit service have less chance to be food insecure than without access ones. This result is fully in conformity with the prior expectation. This is due to the fact that credit gives the household an opportunity to be involved in income generating activities so that derived revenue increases financial capacity and purchasing power of the household to escape from risk of food insecurity. Moreover, it helps to smooth consumption when household face with temporary food problem. The odds ratio of the variable shows that for households with access to credit the probability of food insecure decrease by 0.87.

4. CONCLUSION AND RECOMMENDATION

This study has examined the incidence, extent and essential determinants of food insecurity for urban households in the major towns of Eastern zone of Tigray, namely Adigrat and Wukro. The study shows that 7.4% and 5.4% of households are not able to meet the daily recommended minimum caloric requirement in Adigrat and Wukro, respectively. The percentage of food consumption needed to bring the entire food insecure population to the food poverty line is 2.1% (Adigrat) and 1.5% (Wukro) while the percentage of relative deficiency among food insecure population is 0.1% (Adigrat) and 0.5% (Wukro).

Subsequently, the study has also identified the major factors influencing food insecurity of urban households through empirical investigation. These include: family size, sex of the household head, age of the household head, educational level of the household head, remittance, and access to credit. The study also exhibits that family size and age of the household head have a significant and positive influence on the state of household food insecurity while education of the household head and credit access are negatively and significantly related.

5. REFERENCES

1. Allen, P. (2013), "Facing food security," Journal of Rural Studies, Vol. 29, pp. 135–138.
2. Ashimogo, G. and Hella, J. (2000). Deagrarinisation, household level food security and the environment: The case of Iringa Region. A paper presented for the first RLDS International Policy Research Workshop, Addis Ababa, April 14 - 15, 2000.
3. Bergeron, G. (2002). Food Security in Madagascar: A Situation Analysis. Prepared for the USAID Mission in Antananarivo Washington, D.C.
4. Bigsten, A., Kebede, B., Shimelis, A. and Tadesse, M. (2002), "Growth and Poverty Reduction in Ethiopia: Evidence from Household Panel Surveys", World Development, Vol. 31 No.1, pp. 87-106.
5. BoFED (2018). Socio-economic Household Baseline Survey in Tigray Regional State, Mekelle, Tigray.

6. Bogale, A. and Shimeles, A. (2009), "Household level Determinants of Food Insecurity in Rural Areas of Dire Dawa, Eastern Ethiopia", African Journal of Food, Nutrition and Development, Vol 9 No.9, pp. 1914-1926.
7. Craig J. and Scanlan, J. (2002), "Food Security in Less Developed Countries, 1970 to 1990", American Sociological Review. American Sociological Association, Vol. 66 No. 5, pp. 718-744.
8. CSA (2016/17). Federal Democratic Republic of Ethiopia, Central Statistical Agency, Annual Statistical Abstract, Addis Ababa.
9. CSA (2018). Federal Democratic Republic of Ethiopia, Central Statistical Agency, Annual Statistical Abstract, Addis Ababa.
10. Ethiopian Health and Nutrition Research Institute (1998). Food Composition Table for Use in Ethiopia. Part III, from 1968-1998. A Research Project Sponsored by Government of Ethiopia through former ENI and EHNRI: Addis Abeba.
11. Feleke A. and Bogale. A. (2009), "Determinants and Dimensions of Household Food Insecurity in Dire Dawa Town, Ethiopia", East African Journal of Sciences, Vol 3 No. 2, pp. 134-141.
12. Foster, J., Greer, J. and Thorbecke, E. (1984), "A Class of Decomposable Poverty Measures", Econometrica, Vol. 52 No. 3, pp. 761- 766.
13. Frayne, B., Battersby-Lennard, J., Robert Fincham, R., and Haysom, G. (2009). Urban food security in South Africa: Case study of Cape Town, Msunduzi and Johannesburg. Development Planning Division Working Paper Series No. 15.
14. Gani, A. and Prasad, B.C. (2007), "Food security and human development", International Journal of Social Economics, Vol. 34 No. 5, pp. 310-319.
15. Gazuma E.G. (2018), "An Empirical Examination of the Determinants of Food Insecurity among Rural Farm Households: Evidence from Kindo Didaye District of Southern Ethiopia", Business and Economics Journal, Vol. 9 No 1, pp. 1000-345.
16. Gebre, G.G. (2012), "Determinants of Food Insecurity among Households in Addis Ababa City, Ethiopia," Interdisciplinary Description of Complex Systems, Vol. 10 No. 2, pp. 159-173.
17. Gujarati, D.N. (2004), Basic Econometrics. Fourth Edition, McGraw-Hill, New York, USA.
18. Hoddinott, J. (2001), Methods for Rural Development Projects. Food Security in Practice, Vol1, IFPRI, Washington D.C.
19. Maxwell, D. (1998), "The Political Economy of Urban Food Security in Sub-Saharan Africa", World Development, Vol. 27 No.11, pp. 1939–1953.
20. Maxwell, D., Levin, C., Armar-Klemesu, M., Ruel, M., Morris, S. and Ahiadeke, C. (2000). Urban Livelihood and Food and Nutrition Security in Greater Accra, Ghana. Research Report No.112. IFPRI, Washington, D.C.
21. Mitiku, A. and Legesse, W. (2014), "The Determinants of Rural Households' Vulnerability to Food Insecurity in Jimma Zone, South Western Ethiopia", Journal of Biological and Chemical Research, Vol. 31 No. 1, pp. 62-72.
22. Mitlin, D. (2012). Urban poverty in the global south: Scale and nature.
23. Muche, M., Endalew, B., and Korcho,T., (2014), "Determinants of Household Food Security among Southwest Ethiopia Rural Households", Asian Journal Of Agricultural Research, Vol 8 No. 5, pp. 248-258.

24. Pinstrup-Andersen, P. (2009), "Food security: definition and measurement. Food Security", Vol 1 No. 1, pp. 5–7.
25. Satterthwaite, D., McGranahan G. and Tacoli, C. (2010). Urbanization and its Implications for food and farming, The Royal Society publishing.
26. Ssewanyana, S.N. (2003). Food Security and Child Nutrition Status among Urban Poor Households in Uganda: Implication for Poverty Alleviation. African Economic Research Consortium. Research Paper 130. Nairobi, Kenya.
27. UN (2015). Sustainable Development Goals. United Nations. Available at: https://sustainabledevelopment.un.org/?menu=1300.
28. UNOHCR (2006). The Right to Adequate Food. Fact Sheet num. 34, 41987, 1–10.
29. Vasco, M. (2006). Food Security in Vietnam during the 1990s, World Institute for Development Research Paper, No. 2006/67.
30. Yamane, T. (1967), Statistics: An Introductory Analysis, 2nd ed., New York: Harper and Row.
31. Zerihun, N. and Getachew, A. (2012), "Levels of Household Food Insecurity in Rural Areas of Guraghe Zone, Southern Ethiopia", Wudpecker Journal of Agricultural Research, Vol. 2 No. 1, pp. 008 – 014.
32. Zezza, A. and Tasciotti, L. (2010), "Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries", Food Policy, Vol. 35 No. 4, pp. 265–273.

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PREVALENCE AND ASSOCIATED RISK FACTORS OF TRYPANOSOMOSIS IN CAMELS IN SELECTED DISTRICTS OF AFAR NATIONAL REGIONAL STATE, NORTH EASTERN ETHIOPIA

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ABSTRACT

Camel trypanosomiasis or surra, is a life-threatening disease caused by *Trypanosoma evansi***,** with negative impacts on health, Production and working efficiency of camels in different camel-rearing areas of the world including Ethiopia. A cross sectional study was carried out from November, 2016 to May, 2017 with the aim of estimating the prevalence of camel trypanosomiasis (surra) and assessing of associated risk factors in Dubti and Asayita districts of Afar region, Ethiopia. Blood samples were collected from randomly selected 200 camels. Wet film blood smears and Giemsa-stain were used for the detection of trypanosomes. Out of 200 examined camels, 9(4.5%) were positive for *Trypanosoma evansi*. Higher prevalence of the disease was recorded in Dubti (6.97%) than in Asayita (2.63%). Camels of >4years age group (7.47%) showed higher prevalence of infection compared to those with <4years (1.07%). According to logistic regression analysis, previously aborted camels were found at higher risk (p= 0.698; OR=5.11, 95% CI = 1.174- 22.317). The Chi-square analysis showed that, there was no statistically significant difference between body condition categories and herd size of camels with the occurrence of the disease (X^2=3.839; p=0.147,) and (X^2=0.718; p= 0.698) respectively. The number of animals with lower PCV (anemic) was 49% and those with normal PCV were 51%. The result of this study revealed that camel trypanosomiasis was prevalent in the study area. Thus, designing of the control and prevention strategies with further identifying risk factors is desirable.

Keywords: Afar, Camel, Prevalence, Risk factors, Trypanosoma evansi

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1. INTRODUCTION

The livestock sector support the food security and livelihood of almost a billion people and contributes up to 40% of the global values of agricultural output (Thornton, 2010). Livestock keeping is a multifunctional activity in many developing countries including Ethiopia. Beyond their direct role in generating food and income, livestock are a valuable asset, serving as a store of wealth, collateral for essential safety net and credit during times of crisis (FAO, 2009). Ethiopia is ranking first in Africa and ninth in the world by possessing largest number of livestock population (Yilma and Melese, 2016). The importance of animal products is increasing from time to time both at local and global markets in Ethiopia. Moreover, camel husbandry is the major source of living for millions of pastoralists in the arid and semi-arid areas of Ethiopia (MOA, 2013).

The Camels (*Camelus dromedaries*) are the most numerous species of animals in the arid areas of Africa and Asia, particularly in the arid lowlands of east African counties like Ethiopia, Sudan, Somalia, Djibouti and Kenya) (Abera *et al*., 2015). In Ethiopia camels inhabit almost in all peripheral drier lowlands of the country that generally fall below 1,500 meters above sea level which includes the major parts of the Somali and Afar National Regional States and some parts of the Oromyia National Regional State (Tezera and Kassa, 2002).Ethiopia is estimated to be the third largest camel herd in the world after Somalia, and Sudan (FAO, 2013).

Comparatively Camels are believed less susceptible to many of the devastating diseases that affect different livestock species, such as foot and mouth disease, rinderpest and contagious pleuropneumonia but yet they are affected by many other diseases (Kassa *et al*., 2011). Among the diseases constraints, Parasitism is one of the major problems that affect the productivity of camels. Of these parasitic diseases, camel trypanosmosis is the major problem in sub-Saharan African countries including Ethiopia (Donelson, 2003).

Camel trypanosomosis, also called Surra caused by *Trypanosoma evansi*, is the most important and serious pathogenic protozoan disease of camel. The disease is transmitted mechanically by haematophagous biting flies, especially tabanids (Bamaiyi *et al*., 2011). *Trypanosoma evansi* is the most widely spread endemic disease (surra) of camels and other different domestic animals throughout the world (Elhaig *et al.,* 2013; Shahid *et al.,* 2013). From the two strains of T. evansi: type A and B; strain type A only is believed to be found in Ethiopia whereas, type B has been isolated only from Kenyan dromedary camels (Birhanu *et al*., 2015).

The disease is highly prevalent in Ethiopia (22%) and it is an important cause of economic losses, causing morbidity of around 30.0% and mortality of up to 3.0% in camels in Ethiopia (Abera *et al*., 2015). The true prevalence of the disease is reported by Mohammed *et al.* (2011) in Dire Dawa (1.6%), Bekele *et al.* (2004), in Borona pastoral area (1.8%), in Borena Zone of southern Ethiopia (1.2%) and seroprevalence of 5.22% in Afar (Teshome *et al.,* 2003).

In camels, the disease induce fever, anemia, dullness, depression, weakness, nervous symptoms and these are responsible for major economic losses in terms of poor

production (meat, milk, draught power, fertility, and manure) and sometimes death (Desquesnes *et al.*, 2013). It may occur in both acute and chronic forms, the acute form of the disease is usually fatal within a few weeks, but the chronic form lasts for years and associated with secondary infection (Mihret and Mamo, 2007).

Even if camel trypanosomosis has its ecological, economic importance and significant role in the life of pastoral community, researchers and development planners were not given attention to studying about this disease in Afar region, Ethiopia. Moreover, limited documented information about camel trypanosmosis and associated risk factors in afar regional state, northern Ethiopia particularly in the study area, makes this study to focus on estimating the prevalence of camel trypanosomosis and assessing associated risk factors for camel trypanosomosis in the study area.

2. MATERIALS AND METHODS

2.1. Description of study area

The Afar national regional state is located 587.9 km far from Addis Ababa in northeastern Ethiopia. According to regional estimates, the livestock population of Afar is about 10.12 million, from which about 859,580 (8.5%) are camels. The Afar national regional State has five administrative zones, which are further subdivided into 32 districts. Afar regional state is located between 39^{o}34' and 42^{o}28' East longitude and 8^{o}49' and 14^{o}30' North latitude. It is characterized by an arid and semi-arid climate with low and erratic rainfall. The annual temperature and rainfall in the region is 30-50^{0}C and 200-600mm, respectively. Pastoralism and agro pastoralism is the major livelihood ways practiced in the region. The population of the region is estimated to be about 1.2 million of which 90% are pastoralists and 10% agro-pastoral (CSA, 2007). The study was carried out in two purposively selected districts of Afar region namely; Asayita and Dubti.

2.2. Study population

Study was carried out in indigenous one humped camels which vary with age, and body condition that reared under extensive husbandry system on different district. Herd size was classified into three categories as small (Up to 10 camels in a herd), medium (11-20 camels) and large (More than 20 camels in the herd) based on classification of Faye and Bengoumi, 2006. In addition body condition score of dromedaries was classified according to these authors, which range from 5 (Excellent) to 0 (Very poor). Estimation of age was both on subjective basis and based on information obtained from the owner.

2.3. Study Design

Across-sectional study was carried out to estimate the prevalence of camel trypanosmosis and to assess the associated risk factors in Asayita and Dubti from November 2016 to May 2017. Semi structured questionnaire was prepared and presented to the owner to obtain information about physiological status (dry, lactating or pregnant) and previous abortion history of sampled animals in the herd.

2.4. Sampling Methods

A multi-stage cluster sampling approach was used. The representative zones, kebeles (Peasant Associations) were selected purposely based on accessibility, willingness of pastoralists and camel population. Zones and woredas were the primary and secondary sampling units respectively. From the five administrative zones of Afar region, Zone one was selected and then, from zone one, two woredas (Asayita and Dubti from Zone-1), were selected purposively. Accordingly, 114 (57 %) and 86 **(**43%) camel were sampled from Asayita and Dubti district, respectively. camels were selected from a given herd by using simple random sampling method.

2.5. Sample Size Determination

Cluster sampling is the suitable method for this study as constructing sample frame for random sampling is not possible in pastoral production system. The required sample size was determined by Thrusfield (2007) formula within 95% Confidence Interval (CI) at 5% desired precision level.

$$N = \frac{1.96^2 \times Pex \times (1-Pex)}{d^2} \quad \text{----Equ.1}$$

where:-N= sample size

Pex^{-} Expected prevalence

d^2= desired level of precision

Expected prevalence was taken as 2% reported by Fikru *et al* (2012).

$$N = \frac{1.96^2 x 0.02 \times (1-0.02)}{(0.05)^2} = 30.10$$

Therefore, the minimum sample size required was 30, but in order to increase the precision 200 blood samples were collected.

2.6. Sample collection method

After physical restraining, the jugular furrow of 200 selected camels were cleaned with alcohol and dried well. Then, blood samples were collected by puncturing jugular vein using lancet needle in to 5ml ethylene tetra- acetic acid (EDTA) coated vacoutainer tubes and kept in cooler box and transported to Samara university multipurpose laboratory.

2.7. Laboratory examination procedures

2.7.1 Hematological Examination

Blood samples were drawn into paired heparinized microhaematocrit capillary tubes up to ¾th of their length. One end of the tubes were sealed with crista seal and symmetrically loaded in the hematocrit centrifuge, with the sealed end outwards, and then centrifuged at 12,000 rpm for 5 minutes. PCV levels of individual samples were determined on hematocrit-reader (Hawaksly, England) and the values were expressed in percentages. Animals with Packed Cell Volume (PCV < 25%) were considered to be anaemic (Morag, 2002).

2.7.2 Parasitological Examinations

For wet film, a drop of blood was placed on a clean glass slide and it was covered with cover slip, to allow the blood to spread as a thin layer of cells and then examined under microscope to observe the motile trypanosomes. The air dried smears were fixed in

absolute methylene alcohol for 2 minutes. The slides were immersed in Geimsa stain for 20-25 minute and washed with tap water to remove excess stain. After air drying, the slides were examined under oil immersion objective lens (100x) for the detection and identification of trypanosome species based on their morphological characteristics (Murray *et al.,* 1979*).*

2.8. Data analysis

The data obtained from the study was entered to the Microsoft excel spreadsheet and analyzed by SPSS version 20. The results of this study were taken as statistically significant when p-value is less than 0.05. A chi-square (X^2) test was employed to investigate associations between infection status and risk factors. To investigate the associations between *T. evansi* infections and associated risks, factors identified as significant were subsequently subjected to logistic regression analysis.

3. RESULT ANALYSIS

The parasitological examinations of collected samples revealed that camel trypanosomosis caused by *T. evansi* is widespread and a major threat to the well-being and productivity of the camel population in Asayta and Dubti districts of Awsi Rasu zone, Afar region, Ethiopia. It was detected in 9 (4.5%) of the 200 camels by at least one of the three/two (wet film) parasitological methods. The difference in prevalence between the two administrative districts was not statistically significant (p>0.05). But, the prevalence of trypanosome infection was slightly higher in Dubti (6.97%) than in Asayita (2.63%) (Table1).

Higher prevalence (7.47%) was observed in age group >4 years old compared to <4 years age old category (Table 2). The prevalence of Trypanosomosis was not significantly associated with body condition. However, higher prevalence was recorded in poor conditioned camels (7.52%) than medium (2.94%) and good body condition scored camels (1.36%) (Table2). The prevalence of trypanosomes infection was different between herd size categories, but not statistically significant (P>0.05) (Table 2). There were statistically significant association between the occurrence of the disease and physiological status (p=0.015) and abortion history (p=0.017) of camels.

Table 1. Prevalenceof camel trypanosomiasis in study area

Risk factor	Category	No tested	Positive (%)	Chi-square	P-value
Districts	Asayita	114	3 (2.63%)	2.154	0.142
	Dubti	86	6(6.97%)		
Total		200	9(4.5%)		

Table 2.Prevalence of camel trypanosomiasis among associated risk factors.

Risk factor	Category	No tested	Positive (%)	Chi-square	P-value
Age	Adult	107	8 (7.47%)	4.74	0.029
	Young	93	1 (1.07%)		
Body condition	Emaciated	93	7 (7.52%)		
	Moderate	34	1(2.94%)	3.839	0.147
	Good	73	1(1.36%)		
Herd Size	Small	40	1 (2.50%)		
	Medium	93	4 (4.30%)	0.718	0.698
	Large	67	4 (5.97%)		
History of abortion	Previously Aborted	20	3(15 %)	5.701	0.017
	Not aborted	180	6 (3.33%0		
Physiological status	Pregnant	67	7 (10.4%)		
	Lactating	86	1 (1.2%)	8.35	0.015
	Dry	47	1(2.1%)		

Table 3. Association between trypanosomiasis infection status and mean PCV in camels

PCV status	No.Examined	No.Infected	Mean PCV	Prevalence%	chi-square (X2)	p-value
PCV<25	98	5	20.8%	5.1%		
PCV>25	102	4	27.4%	3.9%	0.162	0.687
Total	200	9	24.2%	4.5%		

Table 4. Logistic regression analysis of risk factors and trypanosomiasis prevalence

Risk factors	No. Examined	No. Infected	P-value	OR	95% CI for EXP(B)
Age					
Adult	107	8	0.061	7.43	0.0912 - 60.59
Young	93	1			

Abortion history						
aborted	20	3		0.03	5.118	1.174- 22.317
Not Aborted	180	6				
Physiological status						
Pregnant		67	7	0.047	-	-
Lactating		86	1	0.034	0.101	0.638-45.169
Dry		47	1	0.122	0.186	0.033-8.854

4. DISCUSSION

The overall prevalence of camel trypanosomiasis in the study area was found to be 9 (4.5%). Trypanosoma evansi was the only species identified during this study, and it is reported to be the cause for camel trypanosomosis from different parts of the world (Swai *et al*., 2011). This study result was higher as compared to other findings in others parts of Ethiopia: 0.3% Issa (Afar) (Tefera, 1985), 2% Tigray (Hailu, 2000) and 3.9% Jijiga (Tadesse et a*l.*, 2012). On the other hand, the finding of this study is lower than the previous reports of 72% Bale Zone (Bogale *et al*., 2012) and 17.9% Jijiga Administrative Zone (Abera *et al*., 2014). The difference in the prevalence rate might be due to the difference in the ecology of the study areas and seasons of the year when the study was carried out. It is clear that season has direct effect on the distribution of biting flies, which are responsible for the mechanical transmission of *T. evansi* (Luckins, 1988).

The prevalence of trypanosomosis between the districts was not significantly (P =0.142) varied and this could be due to similarity in climatic condition. However, higher parasitological prevalence was recorded in Dubti district (6.97%) compared to Asayita (2.63%). The higher prevalence observed in Dubti district could be due to the relative ecological variation, hence, in Dubti district there are numerous communal watering points and the existence of big and medium sized trees and shrubs along with a year round river called Awash River.

In this study, age-wise analysis showed that there was statistically significant difference between age groups and the occurrence of the disease (X^2=4.74,P=0.029) in which higher infection rate was observed above 4 years (7.47%) compared to camels bellow 4 years (1.07%). This result is similar with other findings (Eshetu, 2011; Weldegebrial *et al*., 2012 and Tadesse *et al*., 2014). The higher prevalence of *T. evansi* infection noted in older camels may be due to heavy stress associated with their use for various purposes like transportation of goods and sub-optimal management practices.

In this study, body condition was investigated; higher prevalence of *T. evansi* infection was noted in 7.52% in Emaciated camels, 2.94% was in moderate and 1.3%was in good

body condition camels. However, this risk factor was not significantly associated with disease. This result was in line with the report of Khalid, 2015.

In this study, herd size analysis revealed that there was no statistically significant difference among herd group and the occurrence of the disease (X^2=0.718, p-value=0.698). In other study this risk factor was found statistically significant (Khalid, 2015). Accordingly (Bhutto *et al.,* 2009), reported that infection rate was highest in herds possessing more than 20 animals compared to herds possessing lower number of animals.

The infection rate was 15% in camel having previous history of abortion, and 3.3 % in camels without previous abortion history. Camels with history of abortion were more than 5 folds at risk (OR=5.11; 95% CI=0.045-.8521) of infection than camels with no history of reproductive disorder. This result agrees with (Schillinger and Rottcher, 1986) and (Yagil, 1982) who found that abortion could be due to the chronic form of trypanosomiasis.

Even though, there was no statistically significant difference observed between infection and PCV (P>0.05) (Table 3), this finding was disagreeing with what was reported by Tesfaheywet and Abraham (2012). A significant reduction in PCV was observed in the trypanosome infected animals signifying anemia to be one of the important consequence of infection. But, several factors are responsible for causing anaemia; the production of haemolysin by trypanosomes resulting in extravascular destruction of RBCs, haemolysis of RBCs, the erythrophagocytosis, depression of erythropoiesis, immune mediated and non-specific factors, which increase red cell fragility, might be responsible for anaemia (Atarhouch *et al*., 2003). So, anemia is a major component of the pathology of surra (Enwezor and Sackey, 2005).

There was statistically significant difference between the prevalence of camel trypanosome and physiological status of camels. Pregnant camels were found at high risk of infection by *T.evansi* followed by dry and lactating camels' respectively (P=0.047). This could be due to the occurrence of stress during pregnancy and lactation which may decrease resistance in female and render them more susceptible to *T. evansi* infection. On the other hand, some studies on prevalence and associated risk factors trypanosomiasis due to *T.evansi* in camel have been published, but no information concerning to assessments of prevalence of trypanosomiasis and physiological status of camels.

5. CONCLUSION AND RECOMMENDATION

Although disease is the major constraint, camel rearing has indispensable practice in Ethiopian pastoralists especially in afar regional state as their way of life is dependent on animal production. Camel trypanosomosis, also known as Surra caused by *Trypanosoma evansi*, is the most important and serious pathogenic protozoan disease of camel which continued to be the major problem in Ethiopia particularly in the study areas. The study revealed that camel trypanosomosis is prevalent in afar regional state particularly in the study area at relatively low levels during the study period using parasitological techniques. The present study provides useful baseline data on the

prevalence of camel trypanososmosis in the study area .Therefore, further studies should be carried out on trypanosomosis and associated risk factors in the study area, Effective prevention and control plans should be designed and implemented against the parasite and their vectors to control the disease and there should be expansion of veterinary services to serve the community in Afar region, Ethiopia.

5. REFERENCES

1. Abera, D., Tadesse, B., and Tajudin, B. (2014). Prevalence of camel trypanosomosis at selected districts of Bale Zone, southern Ethiopia. *Science, Technology and Arts Research Journal*, **3(3):** 103-106.
2. Abera, Z., Akil, U., and Zelalem, A. (2015). Review on Camel Trypanosomosis: its Epidemiology and Economic Importance.
3. Atarhouch, T., Rami, M., Bendahman, M., and Dakkak, A. (2003). Camel trypanosomosis in Morocco1 Result of a first epidemiological survey. *Vet. Parasitol*, **111:** 277-286.
4. Bamaiyi, PH., Kalu, AU., and Ali, M. (2011). Haemoparasites of the trade Camel (Camelus dromedaries) arriving for slaughter at Maiduguri, Borno State, Nigeria. *Continental J. Veterinary Sciences*, **5 (1):** 18 – 21.
5. Bekele, MB. (2004). Sero-epidemiological study of brucellosis in camels (C*amelus dromedarius*) in Borena lowland pastoral areas, Southern Ethiopia. MSc Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
6. Bhutto, B., Gadahi, JA., Shah, G., Dewani, P., and Arijo, AG. (2009). Field Investigation on the Prevalence of Trypanosomiasis in Camels in Relation to Sex, Age, Breed and Herd Size *Pakistan Veterinary Journal* ISSN**:** 0253-8318(PRINT), 2074-7764.
7. Birhanu, H., Fikru, R., Said, M., Kidane, W., Gebrehiwot, T., Hagos, A., and Alemu, T. (2015). Epidemiology of Trypanosomaevansi and Trypanosomavivax in domestic animals from selected districts of Tigray and Afar regions, Northern Ethiopia. *Parasit Vectors*, **8:** 212.
8. Bogale, B., Kelemework, F., and Chanie, M. (2012). Trypanosmosis in Camel (Camelus dromedaries) in Delo-Mena District, Bale Zone, Oromia Region, Southwest Ethiopia. *ActaParasitologicaGlobalis*, **3(1):** 12-15.
9. Central Statistical Agency (CSA), (2007). Human and animal population census in Afar region. Addis Ababa, Ethiopia.
10. Desquesnes, M., Holzmuller, P., Lai, DH., Dargantes, A., Lun, ZR., and Jittaplapong, S. (2013). *Trypanosoma evansi* and Surra: A Review and perspectives on origin, history, distribution, taxonomy, morphology, hosts and pathogenic effects, *BioMed. Res. Int.*http://dx.doi.org/10.1155/2013/194176.
11. Donelson, JE. (2003). A review on antigenic variation and the African trypanosome genome. *ActaTropica*, **85:** 391-404.
12. Elhaig, MM., Youssef, AI., and El-Gayar, AK. (2013). Molecular and parasitological detection of trypanosoma evansi in camels in Ismailia, Egypt. *Vet. Parasitol*, **198:** 214-218.
13. Enwezor, F., and Sackey, A. (2005). Camel Trypanosomosis-A Review. *Vet. Arhive*, **75:** 439- 452.

14. Eshetu, Z., Desta, B., and Amare, LB. (2011). Prevalence of Infection in the One-Humped Camel in Jijiga Administrative Zone of the Ethiopian Somali Region. *Global Veterinaria,* **10 (2):** 233-238.
15. Faye, B., and Bengoumi, M. (2006). Assessment of body condition and body composition in camel by barymetric measurements. *J. Camel Pract. Res*, **13:** 67-72.
16. Fikru, R., Andualem, Y., Getachew, T., Menten, J., Hasker, *et al.* (2012). Trypanosome infection in dromedary in easter Ethiopia; prevalence, relativeperforman ceof diagnostic tools and host related risk factors.*veterinary parasitologyhttp://dx.doi.org/10.1016/j.vetpar.2015.04.008.*
17. Food and Agriculture Organization of the United Nations (FAO), (2009). Livestock in balance, *Vialedelleterme di Caracalla00153* Rome, Italy.
18. Food and Agriculture Organization of the United Nations (FAO), (2013). Statistical year book. Rome, Italy.
19. Hailu, D. (2000). The Prevalence of Camel Trypanosomosis in the Salt Convey Routes of Afar-Tigrai. DVM Thesis, FVM, Addis Abeba University Debre Zeit, Ethiopia. ISSN 1992-6197Jijiga ISSN 1992-6197.
20. Kassa, T., Tadesse, E., and Hassen, C. (2011). Prevalence of camel trypanosomosis and its vectors in Fentale district, South East Shoa Zone, Ethiopia. *Vet Arhiv*, **81:** 611- 621.
21. Khalid, AN. (2015). Prevalence and Risk factors of camel trypanosomosis in Butana area Gedarrif State**.** DVM Thesis, FVM, Sudan University of Science and Technology College, Sudan.
22. Luckins, AG. (1988). Trypanosoma evansi in Asia.*Parasitol. Today,* **4:**137-142.
23. Mihret, A., and Mamo, G. (2007). Bovine Trypanosomosis in three districts of East Gojjam Zone, bordering the Blue Nile River in Ethiopia. *J. Infect. Devel. Count,* **1:** 321-325.
24. Ministry of Agriculture and Rural Development (MOA), (2013). Draft document on the establishment of Disease-free zones, Ministry of Agriculture, Ethiopia, 23.
25. Mohammed, O., Megersa, B., Abebe, R., *et al.* (2011). Seroprevalence Brucellosis in camels in and around Dire Dawa City, Eastern Ethiopia. *J. Anim. Vet. Adv.* **10 (9):**1177-1183.
26. Morag, GK. (2002). Hematology in Veterinary Laboratory Medicine 2nd ed., Blackwell science, London, 1-25.
27. Murray, M., Clifford, J., and McIntyreb, W. (1979). Diagnosis of African Trypanosomiasis in bovine.Trans. *Transactions of the Royal society of Tropical Medicine and Hygiene* **17:** 120-121.
28. Schillinger, D., and Rottcher, (1986). Treatment of camels for trypanosoma brucei evansi infection (surra*). World. Anim. rev,* **60:**21-32.
29. Shahid, M., Janjua, S., Abbas, FI., and Burbach, JS. (2013). PCR-based detection of *Trypanosoma evansi* infection in semi-captive Asiatic black bears (Ursusthibetanus). *Pakistan Vet.J,* **3:** 442-445.
30. Swai, ES., Moshy, W., Mbise, E., Kaaya, J., and Bwanga, S. (2011). First field investigation report on the prevalence of trypanosomosis in camels in northern Tanzania. *Roavs***1:**15-18.
31. Tadesse, A., Omar, A., Aragaw, K., Mekbib, B., and Sheferaw, D. (2012). A Study on Camel Trypanosomosis in Jijiga Zone, Eastern Ethiopia. *Journal of Veterinary Advances,* **2(5):** 216-219.

32. Tadesse, B., Dereje, A. and Tajudin, B. (2014). Prevalence of Camel Trypanosomosis at Selected Districts of Bale Zone, Southern Ethiopia. *Sci. Technol. Arts Res. J*, **3(3):** 103-106.
33. Tefera, M. (1985), Study on Productivity and Diseases of the Issa Camel. DVM Thesis, FVM, AAU, Debre Zeit, Ethiopia.
34. Tesfaheywet, Z., and Abraham, Z. (2012). Prevalence of Bovine Trypanosomosis in Selected District of Arba Minch, Snnpr, Southern Ethiopia. Global Veterinaria: **8 (2):** 168-173.
35. Teshome, H., Molla, B., Tibbo, M. (2003). A seroprevalence study of camel brucellosis in three camel-rearing regions of Ethiopia. *Trop. Anim. Health. Prod.* **35:**381-389.
36. Tezera, G. and kassa, B. (2002). Camel Husbandry Practices in Eastern Ethiopia: The Case of Jijiga and Shinile Zones, Nomadic Peoples, **6:**158-179.
37. Thornton, PK. (2010). Livestock production: recent trends, future prospects. The Royal Society, **365(1554):** 2853-2867.
38. Thrusfield, M. (2007). Veterinary Epidemiology, Government Department of Navy, Bureau 3rd UK Black well science Ltd, 182-198.
39. Weldegebrial, GA., Samson, TK., Kidanie, DT., Woldegebriel, TB., Sisay, TH. et al.(2012). Parasitological and serological study of camel trypanosomosis (surra) and associated risk factors in Gabi Rasu Zone, Afar, Ethiopia .*journal of veterinary medicine and animal health* , **7(6):** 234-240.
40. Yagil, R. (1982). FAO animal production and health paper no.26 camel and camel milk food and agriculture of the united nation, rom, 41.
41. Yilma, and Melese. (2016). Rose Bengal Plate Test (RBPT) Based Sero-prevalence of Bovine Brucellosis in and around Chench, Gama Goffa, Southern Ethiopia.

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The prevalence and determent of HIV/AIDS Risky practices among students Afar Regional State, Northeast, Ethiopia 2019

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ABSTRACT

Human immunodeficiency virus deficiency virus remains as a serious public health importance. Practices that expose them to risk of contracting sexual transmitted diseases included HIV/AIDS is that the major effective driver. The aim of the study was to assess risky practices and associated factors for HIV/AIDS infection among students Afar Regional State Northeast, Ethiopia. An institutional-based cross-sectional study was conducted from Decembers 10, 2019 to January 12, 2020, among regular students who resided in university and college students. A pretested structured questionnaire was used per collect of the data. Using the systematic random sampling technique, a total of 800 respondents participated in the study. The data were entered into EPI info version 3.5.3 and moved to SPSS version 20 for analysis. Descriptive statistics bi-variate and multi variable analyses were done. A p-value < 0.05 was considered the statistical significance of the association between factors (independent variables) and risky sexual activity. The Odds' ratio was also used to determine the presence and the degree of association between dependent and independent variables. Among 800 respondents, the magnitude of risky sexual behaviors was found to be 33.1%... The most predictor variables for risky sexual behavior among the students were marital status (AOR = 3.18, 95% CI = 1.96–5.17), year of study (AOR = 3.57, 95% CI = 2.13–5.96), ever visted to nightclubs (AOR = 7.11, 95% CI = 4.88–10.37) and ever chewing Khat (AOR = 2.78, 95% CI = 1.56–4.96) were statistically associated with risky sexual practice. The prevalence of risky HIV/AIDS practice was high, and 33.1% of study participants were engaged in risky practice. Efforts to increase Awareness creation activity on the importance of safer sex behaviors and consequences of substance use like chewing khat through health education and counseling are highly recommended.

Keywords: HIV/AIDS, university and college students, Sexual practice, associated factors. Afar, Ethiopia

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1. INTRODUCTION

Human Immuno-deficiency Virus infection and the consequent acquired immuno-deficiency syndrome continue to be a major health threat at a global level. There are approximately 37.9 million people living with HIV and 32.0 million people have died from AIDS-related illness since the start of the epidemic. [1, 2]

According to a study, young people aged between 15-24 years accounted for 42% of new HIV infections and nearly 80% of them live in Sub-Saharan Africa. Unless appropriate age and institution targeted interventions are adapted, certain unwanted sexual behaviors can put the youth at a greater risk of HIV infection. Groups of individuals who engage in these high-risk sexual behaviors are considered as vulnerable to HIV infection and wish to be watched to control the epidemic[3].

A study conducted in secondary schools of some African countries indicated that 21.6% of scholars started sexual contact before the age of 15 years whiles quite 80% participants who ever had sexual intercourse started sexual intercourse under the age of 18 years[4, 5]. More than 35% had started sexual intercourse before the age of 18 years [6]. According to Ethiopian demographics health services 9% of women were first sexual intercourse before an age of 15 years 40% were before the age of 18 year [7].

Besides other various factors affecting HIV spread, it was observed that SSA youth have multiple sexual partners in their lives which put them at risk for STIs and unintended pregnancies [8] A study conducted in secondary schools of an African country showed that out of 29% of sexually active participants, about 47.7% have had more than one sexual partner [9]. Similarly, different studies conducted in different parts of Ethiopia showed that those who have had sexual intercourse, more than 45% of them had two or more sexual partners in the past 12 months [4, 5, 10, 11].

The studies conducted among school and university students in Ethiopia showed that 25% and 42.1% of the respondents who ever had sexual intercourse had multiple sexual partners respectively [12, 13]. Another study conducted among high school students in Ethiopia showed that 70.5% of the respondents had two or more sexual partners in the past one year of the survey. The mean age of sexual initiation were 16.2 years, a risk factor for Sexually Transmitted Infections (STIs), unwanted pregnancies and other reproductive health-related complications [14].

Furthermore, based on several studies, a general conclusion was made that college students as a group have awareness and knowledge of HIV and modes of its transmission. They are also aware how to prevent infection but continue to practice risky sexual behaviors that increase personal risk of HIV transmission[15].

According to a study report, nearly 71% of students reported to have sexual activity within the last year, while only 27.1% of these are tested for HIV [16]. College students whose behavior puts them at increased risk of HIV infection i.e. participating in sexual activity without condoms, or seldom use of condoms, having a multiple sex

partners, etc.) are ideally the persons who should be tested for HIV[15, 17]. As a population, college students frequently practice those behaviors that place them in the targeted high risk group, increasing their susceptibility to HIV. Among individuals who choose active, consistent and correct condom during sexual act is the only reliable method of HIV prevention. Unfortunately, the degree of consistent condom use throughout all sexual acts among students group continue to be low [15]. Of the nearly 71% of college students who reported sexual activity within the last year, 45% of them reported one partner within the past 12 months, 10% two partners, and 16% three or more partners.[16]

In Ethiopia low access to target reproductive health (RH) care and services for youth contributes to the high burden of RH problems. Over a quarter of all pregnant youths feel that their pregnancies are mistimed, reflecting the limited access of this population to family planning and reproductive health services. These unwanted pregnancies entail significant risks for maternal health, including high rates of delivery-related complications and high abortion rate. Unwelcome pregnancy is one of the major reproductive health challenges faced by the youth in Ethiopia. About 54% of pregnancies to girls under the age of 15 years were unwanted compared to 37% for those aged between 20-24 years [18].

In spite of such informative but scattered studies, only a limited number of specific studies have been conducted to measure the prevalence of risky sexual behavior among university and college students in the country and it is more so in case of afar regional state which constitutes primarily a backwards and pastoralist community. Therefore, it was thought worthwhile to conduct to determine the magnitude of impact of risky sexual practices and its associated factors of HIV infection among college and University students in Afar region, northeast Ethiopia.

2. MATERIALS AND METHODS

2.1 Study setting and participants

An institutional-based cross-sectional study was conducted from Decembers 10, 2019 to January 12, 2020, among regular students who resided in university and college students at Aysita, Gawane and Ambara districts in Afar region, Northeast Ethiopia. These study areas are located on the main street of Addis Ababa-Djibouti high way. A total population of study area 431,065 Of these, 51% are males and 49% are females [19]. It has bars, nightclubs, shisha houses and local drinking houses in hotspot towns which high prevalence of HIV, STIs or behaviors that put study at risk for acquiring HIV infection.

The sample size was calculated using single population proportion formula by considering the basic assumptions using 40.6% taken from the previous study conducted in Bahir Dar city town on risky sexual behaviors among College Students (16); 95% confidence interval, 5% precision, and 10% non-response rate and design effect 3, the final sample size was calculated to be 800.

2.2 Data collection tool and procedures

The questionnaire was primary prepared in English and interpreted into the local language (Afar-af), and then retranslated to English by language experts to check the consistency. The questionnaire is adopted from similar studies conducted in different parts of the world. Five biology graduated as data collectors and one supervisor were employed and trained on the methods, objectives, and the tool before data collection began.

The tool were pre-tested among 5% of study population at collages in afar regional stat to ensure the clarity and applicability of the tool, and then necessary modifications and correction were undertaken. Questions which caused difficulty in the pre-test were rephrased and corrected. Data were collected using self-administered structured questionnaires.

Before data collection, these study participants were given information about the purpose of the study, the possible risks and benefits of participating, the confidentiality of the study, and has right withdrawn from the study any time. Then, informed consent was taken from each participant and the data were collected using an interviewer administered questionnaire. The supervisor and investigators checked the completeness of the questionnaire every day.

2.3 Data processing and analysis

The collected data were checked for completeness, coded and entered into Epi Info version 3.5.3 and was exported to SPSS version 20 for analysis. Binary logistic multivariate analysis was made. Each explanatory variable was first analyzed by using bivariate logistic regression and variables with p-values but 0.2 were further entered in to multivariable logistic regression model to ascertain the independent effect of covariance on risky sexual intercourse within the multivariable analysis, a p-value but 0.05 was considered to figure out the statistical significance of association. Crude Odds ratio (COR) within the bivariate analysis and adjusted odds ratio (AOR) in multivariable analysis with 95% CI were used to assess the presence and strength of association between dependent and independent variables.

2.4 Ethical considerations

The Institutional Review Board (IRB) of the University of Samara, College of medical and Health Sciences approved the study and a support letter was obtained from regional health offices. Respondents were informed about the aim, procedure, possible risks and benefits of participating, the confidentiality, and their right not to participate or withdraw from the study any time. Then, informed verbal consent was obtained from each participant and confidentiality for collected data was also ensured throughout the study process.

2.5 Operational definitions

Consistent condom use: using condom in the right way during each and every sexual intercourse
Non-café: receiving money allocated for students' food service and using elsewhere other than student cafeteria.
Non-regular partner: sexual partner out-off marital union
Out-off campus living: receiving money allocated for dormitory service and living outside the university compound.
Predisposing factor: any condition related to biology, cultural, economic, demographic or personal that can increase the risk of involving in risky sexual behavior
Risky HIV Practice: Varies widely counting on the sort of exposure or behavior (such as sharing needles or having sex without a condom substance use).
Substance use: Use of at least one substance, like khat chewing, cigarette smoking, alcohol drunker…and so on.

3. RESULTS AND DISCUSSION

3.1 Socio-demographic characteristics of students

A total of 800 students participated in the study, the response rate were98.0%. Out of 800 respondents, 526(65.8) % were males and 770 (96.3%) within the age group of 18 to 24 years with a mean ± SD age of 20.20±1.74 years. Majority of the respondents 581(72.6%) were from urban residents, 704 (88.0%) attended public high schools and 310 (38.8%) students used to get a monthly pocket money of 100 to 299 Ethiopian Birr (ETB) (Table 1).

TABLE 1: Socio demographic characteristics of students among Samara University and colleges students, Afar region, Ethiopia, 2019 (n=800)

Characteristics	Frequency	%
Age (in years)		
Mean(± SD)	20.20 ± 1.74	
±18-24	770	96.2
>24	30	3.8
Sex		
Male	526	65.8
Female	274	34.3
Religion		
Muslim	300	37.5
Orthodox	364	45.5
Protestant	108	13.5
Others	28	3.5
Religious attendance		
Yes	456	57.0
No	344	43.0
Marital status		
Ever married	121	15.1

Never married	679	84.9
Ethnicity		
Afar	233	29.1
Somali	49	6.1
Oromo	137	17.1
Tigray	46	5.8
Amhara	323	40.4
Other	12	1.5
Place of origin		
Urban	581	72.6
Rural	219	15.6
School type		
Public high school	704	88.0
Private high school	68	8.5
Missionary high school	28	3.5
Pocket money(ETB)		
<100	106	13.3
100-299	310	38.8
300-499	164	20.5
>=500	220	27.5
Source of pocket money		
Family	640	80.0
Self	8	1.0
Others	152	19.0
Type of institution		
University	402	50.3
Colleges	398	49.8
Field of study		
Non-health sciences	721	90.1
Health sciences	79	9.9
Year of study		
Year one	431	53.9
Year two	227	28.4
Year three	129	16.1
Year four and above	13	1.6
Accommodation		
Café	619	77.4
Non-café	181	22.6
Parents' educational status		
No education	318	39.8
Primary school	248	31.0
Secondary school	72	9.0
college and above	162	20.3

3.2 Sexual behavior of study students

Out of the total participants, 327 (40.9%) of students had life time sexual experience. Of the 327 sexually active students, 231 (70.1%) were males and 96 (29.9%) were females. The Mean (± SD) age at first sex for both males and females was 16.67 ±2.07

years ranging from 12 to 22 years. From the 327 sexually experienced respondents, 271 (82.9%) had their first sex prior to joining the college/university and 56 (17.1%) after joining the college/ university (**Table 2**).

The main reasons for initiating sex were related to personal sexual desire or curiosity 177(54.1%), boy/girlfriend's pressure 49(15.0%), marriage 28(8.2%), sex for money 14 (4.3%), peer pressure 23(7.0%) and other reasons 4(1.2%). Among the 327 sexually active students, 205 (62.7%) students were engaged in sexual activities for the last 12 months with majority of them 157(76.6) reported to have been engaged in sexual activity with their boy or girlfriend and 10 (4.9%) having sex with their commercial sex workers(CSWs).

From the overall sexually active students, who had at least one of the risky sexual behaviors were 265(33.1%), among them 142(43.4%) had life time multiple sexual partners, 107(37.2%) used condom inconsistently, 184 (56.3%) had sexual intercourse before the age of 18 years and 10 (4.9%) males had sex with commercial sex workers. The most common reason reported for avoiding use of condom was trust on the partner 70(65.4%), reduced sexual pleasure by using a condom, 19(17.8%) and hatred for condoms 18(16.8%).

Table 2: Sexual behavior of study students among Samara University and colleges students, Afar region, Ethiopia, 2019 (n=800)

Characteristics	Frequency	%
Risky sexual behavior		
Yes	265	33.1
No	535	66.9
Lifetime Sexual practices of respondents		
Ever had sex		
Yes	327	40.9
No	473	59.1
Age at first sexual contact (in years) (n=327)		
Mean(± SD)	16.67 ±2.07	
<18	192	58.7
≥18	135	41.3
When was first sex (n=327)		
Before joining College/University	271	82.9
After joining College/University	56	17.1
Person had first sex with (n=327)		
Boy/girlfriend	216	66.1
Husband/Wife	94	28.7
Others	17	5.2
Reason for having first sexual intercourse (n=327)		
Sexual desire	177	54.1
Boy/girlfriend's pressure	49	15.0
To maintain relationship (marriage)	28	8.6

Peer pressure	23	7.0	
Curiosity	36	11.0	
Economic benefit (for males only)	14	4.3	
Alcohol effect	12	3.6	
Other reasons	4	1.2	
Number of sexual partners (life time)			
One	185	56.6	
One and above	142	43.4	
Sexual behaviors of respondents in the last 12 months			
Had sexual intercourse in the past 12 months (n=327)			
Yes	205		62.7
No	122		37.3
Person ever had sex with in the last 12 months(n=205)			
Boy/girlfriend	157		76.6
Husband/Wife	33		16.1
CSWs (for males only)	10		4.9
Others	5		2.4
Number of sexual partners in the last 12 months			
One	152		74.1
One and above	53		25.9
Condom use of respondents (n=327)			
Ever used condom (n=327)			
Yes	220		67.3
No	107		32.7
Frequency of condom use(n=220)			
Always	165		75.0
Occasional	29		13.2
Rarely	26		11.8
Ever used condom for first sexual encounter (n=220)			
Yes	132		60.0
No	88		40.0
Ever used condom for last sexual encounter (n=220)			
Yes	125		56.8
No	95		43.2
Reason for not using condom(n=107)			
I trust my partner	70		65.4
Not comfortable	18		16.8
Do not like	6		5.6
Reduces sexual pleasure	19		17.8
Do not trust condom	16		15.0

3.3 Substance use behaviors of students

Preceding the survey, out of the total participants, 208 (26 %) students were an experience of using some substance, and 82(10.3%) of them chewed khat at least once in their lifetime. The frequency among males 132(69.8%) was higher as compared to females 59(29.2%). Collectively, response to chewing pattern indicated that about half

of them (49.5%) chew khat occasionally (2-3 times per week) and 28.2% daily. (**Table 3**).

Table 3: Substance use behaviors of students among samara University students, Afar region, Ethiopia, 2019. (n=800)

Characteristics	Frequency	%
Ever chew khat		
Yes	82	10.3
No	718	89.8
Ever drunk alcohol		
Yes	101	12.6
No	699	87.4
Ever smoking cigarette		
Yes	25	3.1
No	775	96.9
See pornographic movies		
Yes	299	37.4
No	501	62.6
Believe on pornography(n=299)		
Yes	131	43.8
No	168	56.2
Ever went to night clubs		
Yes	233	29.1
No	567	70.9

Table 4: Factors associated with risky ssexual behavior of study students among Samara University and Colleges students, Afar region, Ethiopia, 2019 (n=800)

Characteristics	Risky sexual behaviour		COR(95%CI)	AOR(95%CI)
	Yes	No		
Age (in years)				
<18	5(26.3)	14(73.7)	1	1
18-24	244(32.5)	507(67.5)	1.35(0.48-3.78)	0.85(0.26-2.76)
>24	16(53.3)	14(46.7)	3.20(0.92-11.15)	0.98(0.23-4.24)
Sex				
Male	182(34.6)	344(65.4)	1.22(0.89-1.67)	1.09(0.71-1.67)
Female	83(30.3)	191(69.7)	1	1
Marital status				
Ever married	61(50.4)	60(49.6)	2.37(1.59-3.50)	**3.18(1.96-5.17)***
Never married	204(30.0)	475(70.0)	1	**1**
Place of origin				
Urban	185(31.8)	396(68.2)	1	1
Rural	80(36.5)	139(63.5)	1.23(0.89-1.71)	1.10(0.72-1.69)
Monthly pocket money(ETB)				
<500	173(29.8)	407(70.2)	1	1
>=500	92(41.8)	128(58.2)	1.69(1.23-2.33)	1.24(0.79-1.92)

Year of study				
Year one	114(26.5)	317(73.5)	1	**1**
Year two	65(28.6)	162(71.4)	1.12(0.78-1.59)	0.77(0.48-1.21)
Year three and above	86(60.6)	56(39.4)	4.27(2.87-6.36)	**3.57(2.13-5.96)***
Accommodation				
Café	180(29.1)	439(70.9)	1	1
Non-café	85(47.0)	96(53.0)	2.16(1.54-3.03)	1.68(0.99-2.68)
Ever went to night clubs				
Yes	152(65.2)	81(34.8)	7.54(5.37-10.59)	**7.11(4.88-10.37)***
No	113(19.9)	454(80.1)	1	**1**
Ever drink alcohol				
Yes	41(40.6)	60(59.4)	1.45(0.95-2.22)	1.44(0.84-2.46)
No	224(32.0)	475(68.0)	1	1
Ever chewing Khat				
Yes	34(41.5)	48(58.5)	3.26(2.04-5.20)	**2.78(1.56-4.96)***
No	501(69.8)	211(29.3)	1	**1**

***significant at P<0.05

4. Discussion

This study provides insight in to the prevalence and risk factors associated with risky sexual behavior using composite practices among colleges and University students in study area. The study revealed that 33.1% [95% CI: 29.9%-36.5%] of the students have had risky sexual practices before the surveys conducted. A finding having relatively similarity with the earlier studies conducted at Jimma University, 32.9% and Bahirdar, private College, 40.6% [20, 21].But the prevalence is lower than studies conducted in Ethiopia and other African counters [22-24]. The reason for such difference might be attributed to the difference in socio-demographic characteristics and previously exposer of study population. In addition, the mean age at first sexual intercourse in this study was 16.7 years. This finding is almost similar with study conducted in Jimma University [25]

The main predictor variables for risky sexual behavior among students were: marital status, year of study, ever visits to night clubs and ever chewed khat. In this study, marital status showed a significant association with increasing risky sexual behavior 3.2 times higher among ever married students than those of never married or unmarried students. This finding is consistent with EDHS 2016, where never-married individuals were more likely to use condom compared to married individuals [7].This might due to fact that never-married individuals were more likely to use condoms compared to married individuals to protect themselves from the infection. [20, 26]

Our study revealed 58.7% students had early sexual debut (<18years); similar study were reported from Cameroon University 55% [27]. But the findings are comparatively higher than Haramaya University scored 43.5 % & Bahir Dar University were 24.3 %[28, 29]. But slightly higher than a study in this study. The disparity might be because of the difference in the focused population groups of the previous studies. This is

another nation, culturally different. Lower findings in study done years ago at in Ethiopian universities 75.6% and 72.8% respectively are explained by the obvious time gap and the media interventions on sexual health [29, 30].

In this study, year of study showed a significant association with increasing risky sexual behavior and was 3.6 times higher among fourth year compared to first year students. This could be attributed to the fact that with increase in the study years, students get engaged in sexual practices and increases their potential of having multiple partners due to the effects of social media, their academic failure and substance use. This finding was supported by other research findings which advocated year of study as a risk factor of risky sexual practices [20, 22]

The students who were going to night clubs and chewing Khat showed significant association with increasing risky sexual behavior by 7.1 and 2.8 times higher respectively among those students who never visited night clubs and chewed khat .

This might be a coherence those students who chew khat and go to night clubs drink alcohol and alcohol leads to decrease in inhibitions, alters rational decision-making and increases risk taking behavior. Moreover, studies showed there is a strong association between khat chewing and alcohol consumption, and the combined use of both substance had an amplifying effect on sexual risk behaviors that predispose to HIV [6]. This study is consistent with the study conducted in other communities[20, 24].

This study interpreted the following limitations include, the cross-sectional nature of the study does not allow establishing causality relationships between the predictors and risky sexual behaviour [31]. Other concerns the representativeness of the sample. Although students from a good range of socio-economic background were included, the findings might not necessarily generalize to students living in further college and university or out-of-school adolescents whose living conditions and lifestyle could also be different.

Self-reported measures, there are created biases and thus the potential for both under reporting and over-reporting within the reports[32]. Given the cultural norms governing sexual behavior, it's likely that the gender difference is caused partially by over-reporting by boys and under-reporting by girls[33]. Findings from our study might be limited by the unknown reliability and validity of the scales which were adapted from previous studies conducted in developed countries. Despite this limitation, the study provides useful information risk of practice on HIV and associated factors that plan to design a strategy to reduce the prevalence of risk practices habit and its adverse social and health consequences. The strength of this study was the request of complex risky behaviors together to measure the student's risky sexual behavior. This can clearly indicate the burden of this misbehavior among sexually active students at this school.

Additionally, study were tried to minimize social desirability bias through administration of self-administered questioner, stile because of sensitive nature of the problem, the possibility of underestimation cannot be ruled out.

4. CONCLUSION AND RECOMMENDATION

The study showed an overall magnitude of 33.1% for risky sexual behaviors by Samara University and colleges students of Afar region. The main predictor variables for risky sexual behavior among the students were: marital status, year of study, ever went to night clubs and ever chewed Khat, in the study areas. Awareness creation on the importance of safer sex and consequences of using substances such as chewing khat, together with taking necessary disciplinary measures for individuals, who break the rules and regulations set by the university/colleges, is highly recommended. The study districts health office has to include these factors HIV risk prevention and health promotion activities to reduce risky sexual practices. The Afar Education Bureau and the city education department have to design ways to deliver at least a high school education for young population.

5. REFERENCES

1. Horton, Richard, Who should lead UNAIDS?. The Lancet. 2019 ;394(10192):12.
2. Unaids J. Fact sheet—latest global and regional statistics on the status of the AIDS epidemic. Geneva: UNAIDS. 2017.
3. World heaalth organization, Joint United Nations Programme on HIV/AIDS (UNAIDS, World Health Organization (WHO. AIDS epidemic update, 2009. UNAIDS; 2009.
4. Dekeke GD, Sandy PT, Factors influencing Sexual Risk Behaviors among Senior Secondary School Students (Youths) of Enemay district, East Gojjam Zone, Ethiopia.. International Journal of Scientific and Research Publications. 2014; 4 (8): 2250–3153.
5. Agajie M, Belachew T, Tilahun T, Amentie M., Risky sexual behavior and associated factors among high school youth in Pawe Woreda, Benishangul Gumuz Region. Science Journal of Clinical Medicine. 2015 Jun 25;4(4):67-75.
6. Derese A, Seme A, Misganaw C, Assessment of substance use and risky sexual behaviour among Haramaya University Students, Ethiopia." Science Journal of Public Health .2014;2(2): 102-110.
7. CSA, ICF Demographic, and ICF Ethiopia. Health Survey 2016:key Indicators Report. Addis Ababa, Ethiopia, and Rockville,Maryland, USA. 2016.
8. Magu Dennis G, Wanzala Peter W, Mutugi Marion W. W NLP, Sexual Risky Behaviours among the Youth in Kenya. Medicine Science 2012;1(3):11.
9. Lyimo EJ, Todd J,Richey LA,Njau B, The association between social networks and self-rated risk of HIV infection among secondary school students in Moshi Municipality, Tanzania. SAHARA-J: Journal of Social Aspects of HIV/AIDS. 2013;10(3-4):131-9.
10. Negeri EL, Determinants of risky sexual behavior, relation between HIV risk perception and condom utilization among Wollega University Students in Nekemte Town, Western Ethiopia. Science, Technology and Arts Research Journal. 2014;3(3):75-86.
11. Amsale C, Berhane Y. , Factors associated with adolescent risky sexual behavior among school adolescents in Addis Ababa, Ethiopia. World Journal of AIDS. 2012;2:6.

12. Bogale A , Seme A, Premarital sexual practices and its predictors among in-school youths of shendi town, west Gojjam zone, North Western Ethiopia.Reproductive health.2014;11(1):49.
13. Bedassa SB, Risky sexual behaviour and predisposing factors to HIV/STI among students in Mizan-Tepi University (A Case of Tepi Campus). Science Journal of Health. 2015 ;3(5):605-11.
14. Deyessa N, Tesfaye G., Intention to use condom among students in Agena preparatory school, Guraghe Zone, Ethiopia: with the application of health believe model. Archives of public health. 2013 Dec 1;71(1):23.
15. Lewis JE, Miguez-Burbano MJ, Malow RM., HIV risk behavior among college students in the United States. College Student Journal. 2009 Jun 1;43(2):475-92.
16. Association, A.C.H., American College Health Association—National College Health Assessment II: Undergraduate reference group executive summary spring.2012.
17. Caldeira KM, Singer BJ, O'Grady KE, Vincent KB, Arria AM, HIV testing in recent college students: prevalence and correlates. AIDS Educ Prev. 2012 Aug; 24(4):363-76.
18. Ethiopia MoH, National Adolescent and Youth Reproductive Health Strategy. In: Health F, editor. Addis Ababa, Ethiopia. 2006.
19. Ethiopia Office of the Population Housing Census Commission, Summary and statistical report of the 2007 population and housing census: population size by age and sex.Federal Democratic Republic of Ethiopia, Population Census Commission.2008.
20. Alamrew Z, Bedimo M, Azage M, Risky sexual practices and associated factors for HIV/AIDS infection among private college students in Bahir Dar City, Northwest Ethiopia.Hindawi ISRN Public Health. 2013
21. Qiao F, Li Q,Yu L, Updated Traffic Flow Dispersion Model Considering Effects of in-Vehicle Advisory Messages,J Civil Environ Eng; 2017;7(270):2.
22. Wordofa D, Shiferaw S, Sexual Risk Behaviors and its Associated Factors among Undergraduate Students in Madda Walabu University, Southeast Ethiopia: A Facilitybased Cross Sectional Study. Epidemiology: Open Access. 2015 ;5(4).
23. Salameh P, Zeenny R, Salamé J, Waked M, Barbour B, Zeidan N, Baldi I, Attitudes towards and practice of sexuality among university students in Lebanon. Journal of biosocial science. 2016 Mar;48(2):233-48.
24. Mamo K, Admasu EM, BERTA MM, Associated Factors of Risky Sexual Behavior among Debremarkos University Regular Undergraduate Students, Debremarkos Town North West Ethiopia, 2016. Journal of Health, Medicine and Nursing. 2016.
25. Tura G, Alemseged F, Dejene S, Risky sexual behavior and predisposing factors among students of Jimma University, Ethiopia. Ethiopian journal of health sciences. 2012;22(3). 2012.
26. Yi S, Poudel KC, Yasuoka J, Palmer PH, Yi S, Jimba M, Role of risk and protective factors in risky sexual behavior among high school students in Cambodia. BMC public health. 2010 Dec 1;10(1):477. .
27. Noubiap JJ, Nansseu JR, Ndoula ST, Wang B, Jingi AM, Bigna JJ et al, Prevalence and correlates of HIV-risky sexual behaviors among students attending the Medical and Social Welfare Center of the University of Maroua, Cameroon. BMC research notes. 2015 Dec;8(1):635.

28. Derese A, Seme A, Misganaw C. , Assessment of substance use and risky sexual behaviour among Haramaya University Students, Ethiopia. Science Journal of Public Health. 2014;2(2):102-10.
29. Mulu W, Abera B, Yimer M., Prevalence of Human Immunodeficiency Virus infection and associated factors among students at Bahir Dar University. The Ethiopian Journal of Health Development (EJHD). 2014;28(3):PDF-.
30. Tura G, Alemseged F, Dejene S, Risky sexual behavior and predisposing factors among students of Jimma University, Ethiopia. Ethiopian journal of health sciences. 2012;22(3).
31. Kliewer W, Murrelle L, Risk and protective factors for adolescent substance use: findings from a study in selected Central American countries. Journal of adolescent health. 2007 May 1;40(5):448-55.
32. Le TN, Kato T, The role of peer, parent, and culture in risky sexual behavior for Cambodian and Lao/Mien adolescents. Journal of adolescent health. 2006 Mar 1;38(3):288-96.
33. Douthwaite MR, Sareoun L: , Sexual behavior and condom use among unmarried young men in Cambodia. AIDS Care 2006, 18:505-513.

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A Study of Social genetics and Linguistic Inquiry

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ABSTRACT

Human being on Earth has undergone several transitions during its history, from the fire age to modern technology. There has been notable progress in linguistic development and social development. Sociolinguistics and Social genetics as a newly emerging discipline have strong relationship and engaged with one another. This study focus on the critically analysis of social genetics and linguistic inquiry of human being regardless of anything. The objectives of the study were to introduce this complex idea to the biologists and linguists to reduce their racial biases and to make sense of social genetics and sociolinguistics are the major parameter of human race and genetics than hereditary genetics. The critical paradigm is used as paradigm of the study. Regarding techniques of data analysis, the qualitative approach is utilized in this study. Concerning data collection tools, the secondary data were collected from journals, findings of different researches, books, and proceedings. Therefore, this research is a desktop research. To mention some of the findings, the concept of hereditary genetics distinguish an individual or a group of individual from the other is a reputational way that triggers a misconception, and incorrect. The world outlook, and paradigm of the target speech community or an individual is not a consequence of hereditary genetics, rather this can be considered as a misconception of genetics. 99.9% of the DNA of two human is identical. But also, more than 99% of language of the world share same consonants and vowels. The phoneme chart of language of the world is almost the same. Therefore, ethnic conflict in different part of the world particularly Africa, Arab countries, and Asia has no theoretical and practical background. More explicitly, ethnic conflict among two races has no reason and a conflict between groups are those share 99.9% of the DNA and 99% of the linguistic characteristics.

Keywords: social genetics, sociolinguistics, proto-language, proto-world language

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1. INTRODUCTION

The concept of genetics has been described from different perspectives by scholars. These scholars try to present genome from both hard science and soft science in general. More explicitly, the concept is presented from biology, and sociology perspectives. This study attempted to assess the concept of social genetics from linguistics perspectives. Linguistics as a sub-field of humanities and interdisciplinary subject can be considered as a social genetics.

The researcher was interested in identifying the role of linguistics in social genetics on the one hand and genres of genetic science as a social genetics on the other hand.

In sociolinguistics the concepts language and related components of humanitarian entity such as culture, value, norms, assets, philosophy, wisdom, are acquired from the environment. This notion predominantly introduced in linguistics. Currently in the development of social genomics bringing together humanities, social science and genetic research in general and sociolinguistics, sociology and biology in particular.

Numerous scholars categorized human being based on color, language, shape of face, size of eye, position of nose and ear, color of hair and eye, type of hair, cognitive competence, and so on. However, this study tried to analyze critically the social genetics and linguistic inquiry of human being regardless of anything. Therefore, this research is a baseline study and unique in its approach.

The objectives of the study are as follows:

To introduce this complex idea to the biologists and linguists to reduce their racial bases.

To make sense of social genetics and sociolinguistics are the major parameter of human race and genetics than hereditary genetics.

2. Literature Review

Numerous research finding depict that, the science of genetics has been used to justify policies that helped one race by harming another (Jackson & Depew, 2017). Even today the belief that races are genetically dissimilar is used to justify interethnic hostility (Kimel, Huesmann, Kunst, & Halperin, 2016), prejudice Dar-Nimrod & Heine, 2011), segregative behavior (Williams & Eberhardt, 2008), and discriminatory policies (Soylu, Estrada-Villalta, & Adams, 2017).

Research suggests that, the relationship between perceptions of human genetic variation and stereotype endorsement is mediated by genetic essentialism (Dar-Nimrod & Heine, 2011; Donovan, 2015b). Genetic essentialism of race is a social cognitive bias which assumes that the genes inherent in people make same race individuals physically and behaviorally uniform and people of different races physically and behaviorally discrete (Andreychik & Gill, 2014).

Over the last 300 years the oppression and subjugation of various ethnic groups around the world has been rationalized through the idea that inequality is a natural product of human biological difference (Doron, 2012; Hudson, 1996; Mallon, 2013; Morning, 2011; Smedley & Smedley, 2005; Wolf, Kahn, Roseberry, & Wallerstein, 1994).

Particularly in Europe and in those continents colonized by Europeans, science education has also been used to lend false credence to the belief that Western Europeans are biologically superior to other groups (Morning, 2011; Willinsky, 1998). Unfortunately, this belief is still apparent in education today as a sociolinguistics field of proto language family and genetic relatedness between the native speakers of the languages under the same language phylum. In this regard, there are different assumptions. The first is the premise that people of the native speaker of same language family are genetically uniform. Such argument may resulted to anachronistic in globalization era.

Studies shows that, uniformity and discreteness beliefs about race are biologically flawed, it should come as no surprise that there has never been any agreement within the biological or anthropological sciences about whether human races are biologically real (Jackson & Depew, 2017; Morning, 2011). Even today there is no scientific consensus that race is biologically real (Foster, 2009; Kaplan & Winther, 2013a, 2013b; Weiss, 2008; Yudell, Roberts, DeSalle, & Tishkoff, 2016). Because, the source of human being is East African Ethiopia. The same source which is very hard to depart one from the other based on language or history.

When people are led to believe that scientists can distinguish one group from another based on traits that are similar within a group and different between groups, they are more likely to search for an underlying essence to differentiate in groups from outgroups (Yzerbyt et al., 2001). Increased belief in an inherent essence then leads individuals to evaluate in groups more favorably than outgroups (Yzerbyt et al., 2001) and to categorize people into more discrete racial groups (Chao et al., 2013).

According to, J. Schnittker & J. Behrman (unpublished manuscript) quoted in Jeremy Freese and Sara Shostak (2009) raise the possibility that estimates of the strong positive effect of schooling on social connectedness may be confounded by unobserved characteristics that cause differences in educational attainment. They find greatly diminished and even sometimes negative effects when attention is restricted to monozygotic (MZ, identical) twins. Because MZ twins share not only genetic endowments but also generic features of family background and cohort, the strategy of estimating effects by comparing MZ twins eliminates a wide variety of potential confounders. Even so, MZ twins do not differ in educational attainment randomly, and estimates following this strategy may still be confounded by psychological and other characteristics that are not fully determined by genes and shared family environment. In other words, if one believes that cognitive ability confounds an estimated effect of educational attainment and also that genes are only one determinant of cognitive ability, then genetically informed designs still do not account fully for cognitive ability as a confound.

According to Jeremy Freese and Sara Shostak (2009), Social science and genetic science still have fairly little engagement with one another, but the continued swift development of genetic science has certainly gained social scientists' attention. First,

some social scientists are incorporating techniques from quantitative and molecular genetics into their work.

Studies shows that Americans develop incorrect ideas about human genetic variation for two possible reasons. First, there is a lot of misinformation about race and genetics in our culture (Beckwith, 2013; Lewontin, 1996). This misinformation has been promulgated by individuals who have a racially biased social agenda (Beckwith, 2013; Lewontin, 1996). Such individuals try to convince other people that racial stereotypes are caused by genetics because they want to mislead people into thinking that racial inequality is natural and therefore not worthy of redress (Graves, 2015; Morning, 2011; Smedley & Smedley, 2005). People who have been misled may then use stereotypes as a way to make sense of the social world around them, further reinforcing the false idea that racial inequality is genetic (Jost, Banaji, & Nosek, 2004; Morin-Chassé, Suhay, & Jayaratne, 2017). Second possible reason why people tend to believe misleading information about the race is because people live in segregated communities in the United States (Allport, 1954; Clark, 1991). As segregation causes social isolation, it prevents people from seeing that individuals in another group are similar to them (Allport, 1954). It could also prevent them from seeing that they differ from people in their own group in the same way that people in another group differ from each other.

Twenty-five years ago, serious scholars could credibly speculate that genetic differences might prove of only trifling importance for understanding individual differences in psychological characteristics, behaviors, and life attainments (Lewontin et al. 1984). Now, the terrain has shifted to arguments that genetic influence should not be overstated and can only be understood in a context of extensive causal interdependence with the social environment (Pescosolido 2006, Rutter 2006).

2. MATERIALS AND METHODS

For this study the critics is used as paradigm. Regarding techniques of data analysis, qualitative approach is utilized. Concerning data collection tools, the secondary data are collected from journals, findings of different researches, books, and proceedings. Therefore, this research is desktop research.

3. Data Analysis and Presentations

The researcher used the concept of proto-world language from proto-language perspective. Let present this concept from sociolinguistics perspective. For instance, language family is a group of languages with a common ancestor. This common ancestor is referred to as a protolanguage. Ancestor in this case is the linguistic features that shared by those languages shared same language family. These has nothing to do with genetic relationship of a group of people spoken these languages. In this case the protolanguages of different families also had ancestors, which must have been members of older language families. Many of the branches of these older families may still exist, but they have separated so much that we are not able any longer to discover the family ties.

More explicitly, according to the data obtained from different journal shows that the source of most language of the world are one and same. They were developed from common source. Evidence of a common origin for groups of languages was readily available in Europe, in that French, Spanish, Italian, and other Romance languages were clearly descended from Latin. The researcher's argument is not only most but also source all language of the world are the same. The source of human being is the same, East Africa particularly Ethiopia. It was convincingly examined the hypothesis that there was once a language from which many of the languages of Eurasia have derived. This common ancestor is referred to as a protolanguage. The classification of this languages into different language family are typological classification and genetic classification. These classification contains less than 1 % of differences in language feature. Like 99.9% of the DNA between any two humans is similar. More than 99% of the characteristics and linguistic feature of human language of the world are identical. For instance, Afaan Oromoo and Tigrigna languages, regardless of their language phylum classification the pulmonic consonants found in Afaan Oromoo is found in Tigrigna except the pharyngeal sound /ʕ/. In addition, all non-pulmonic consonants found in Tigrigna are found in Afaan Oromoo except implosive soung /ɗ/. Besides the vowels all are identical in both languages. This classification has nothing to do with the hereditary genetics of a target speech communities.

Besides, Linguists do not agree about the number of language families in the world. Some linguists may be of the opinion that some two language groups are related that is, that they are branches of a single family while others reject the evidence meant to prove the relatedness, concluding that the two groups constitute separate language families.

Is all languages of the world are related? This is a reasonable question to ask. But, how one can prove this? Here it is good to introduce the notion of phone in linguistics. Like an atom is a smallest unit of matter that decomposed into further molecules in chemistry, sound is the smallest unit that can be described further based on place of articulation, manner of articulation and status of glottis. To start with consonants, basically consonants are divided into two. Pulmonic and non-pulmonic consonants. The pulmonic consonants are produced bt the air come from the lung. Most pulmonic consonants are found in most languages of the world. Therefore, most languages of the world share these consonants in common. The consonants are many in number. Similarly, non-pulmonic consonants are produced above the larynx. These consonants are few in number when compared with that of pulmonic consonants. The non-pulmonic consonants composed of clicks, ejectives and implosives. Some languages of the world shared these consonants in common. Therefore, reconstructing proto-world languages in all parts of the world

Similarly, the feature of most vowels of languages of the world are almost the same or nearly the same. The vowels /a/, /e/, /i/, /o/, and /u/ are the vowels shared by most languages of the world. Therefore, most languages of the world shared the vowels and consonants in common. This can pave the way for monogenesis hypothesis more

convincing than that of a polygenesis hypothesis. In this case almost all languages of the world are from common ancestry.

On the other hand, language change is the universal nature of human language of the world. Language change can be exist in different ways. Sometimes the meanings of lexicons, vocabularies and words are changed. In addition, ways of pronunciations of the lexicons, vocabularies, lexemes and words are changed. Moreover, through word formation process new words are adopted, old words are discarded, inflections come and go, in some languages the linguistic structure such as words, phrases, clauses, and sentences are changed. For example the Latin word Brothren became Brother in English, the Ge'ez /k'ätälä/ 'he killed' became /gädälä/ 'he killed' in Amharic, in Latin /habe:re/ 'to have' became /ave:re/ 'he have' in Italain, and /ho:ra/ 'time, hour' in Latin became /o:ra/ 'time, hour in Italian. /okto:/ ,/ojtu/ , /oʧo/, /otto/, and /opt/ are eight in Latin, Portuguese, Castilian, Italian, and Romanian respectively. These feature is the among the major characteristics of language of the world.

In human language if sound correspondences can be established regularly between two or more languages, these languages are belong to same language phylum or the languages are genetically related, that is, they belong to the same language family and are descendants of the same protolanguage. It has nothing to do with human hereditary genetics.

In principle the language family tree is conventional. According to Ross M (2006:500) a conventional family tree of the Germanic languages and serves as a starting point for a discussion of the family-tree model. It shows that the family concept is recursive. Thus, English, Friesian, etc. form a West Germanic family. This, together with the North Germanic family and the single-member East Germanic family, forms the Germanic family. The latter, along with the Romance, Balto-Slavic, Indo-Iranian, and other, some single-member, families, is part of the Indo-European family. Language family tree cannot do justice to the historical relationships between the languages. This shows that language family tree is not something related to hereditary genetics of the speakers of the language.

On the other hand, the origins of the phylogenetic diversity of languages lie far back beyond know ability. Are all today's language families descended from a single 'ProtoWorld'? Many people have assumed so, not on linguistic evidence but on the basis of a single human origin in east Africa. The comparative method allows us to reconstruct linguistic history only as far back as about 8000 years, yet structurally modern language has probably been around for 100 000 years (ibid).

The romance languages spoken in different countries share nearly the same lexicon for the word key. For example, in Franco-Provençal /clâ/, in French /clé/, in Occitan /clau/, in Catalan /clau/, in Spanish /llave/, in Romansch /clav/, in Piedmontese /ciav/, in Romagnol /cêv/, in Italian /chiave/, in Sicilian /chiavi/, in Sardinian /ciae/, in Portuguese /chave/, in Romanian /cheie/, in Aromanian /cljai/, and in Istriot /ciave/. Such feature is common in most language of the world. That is why the researcher argue on the concept of one proto-language ought to be created for the languages spoken as mother of languages spoken in third planet.

According to Wikipedia, the Tutsi appear to share a close genetic kinship with neighboring Bantu populations, particularly the Hutu. However, these people made war against each other two decades before. The world ought to learn from this. The Tutsis are thought to have originally come from Ethiopia and arrived after the Hutu came from Chad. In this universe at communal level nothing is yours. Everything is ours. Rwanda belong to all human being.

Language is a tool to social contraction not deconstruction. Look at the following language cause for civil war between Hutu and Tulsi:

- Hutu daughters are more suitable and conscientious in their role as woman, wife and mother of the family. Are they not beautiful, good secretaries and more honest?
- Every Tutsi is dishonest in business. His only aim is the supremacy of his ethnic group.
- Hutu should stop having mercy on the Tutsi.
- Must constantly counteract Tutsi propaganda.
- Hutu must be firm and vigilant against their common Tutsi enemy.
- Hutu Ideology, must be taught to every Hutu at every level. Every Hutu must spread this ideology widely.

  Source: first appeared in the Kangura newspaper 1990, Kigali Rwanda

If speaking same language is an indecator of same genetic hereditary, Hutu and Tulsi speak same language called Rwanda-rundi. Hutus speak Rwanda-Rundi as their native tongue, which is a member of the Bantu subgroup of the Niger–Congo language family. Rwanda-Rundi is subdivided into the Kinyarwanda and Kirundi dialects, which have been standardized as official languages of Rwanda and Burundi respectively. It is also spoken as a mother tongue by the Tutsi and Twa. Above all humanity and social genetics must given prior.

A new word, steganography, which is the art of hiding information in electronic text, entered English language with the internet revolution. Verbs like disrespect and download entered the language quite recently, as have nouns like byte and email (Fromkin V. At al 2003 :73).

According to Victoria people start disrespecting each other post internet revolution. Pre internet revolution people are very eager to respect each other. This signals are blinking in Ethiopia. Ethiopia's indigenous culture which pave the way to respect each other for a long period of time seems dematerialize. This is true to most countries of the world. In addition, post internet revolution more lexicons are produced in English.

4. CONCLUSION AND RECOMMENDATION

In sum, the finding of the study demonstrate that it is incorrect to think that the speaker of same language and languages of same phylum are from the same race and genetically uniform. Besides, language is not the only guaranty for genetically relatedness. Instead, being human by itself is the only common characteristic of people of the world.

The pioneer objective of language is communication. English means not UK or British. Rather, it is just a language spoken in different part of the world. That is why Nigeria adopted English as an official language. German is a language spoken in countries like Germany, Australia and so forth. The same is true to French. Therefore, it better to think things from this perspective in order to create harmony and positive thinking among people of the world and target speech communities. Especially, in Africa and Asia language should not be a means of ethnic conflict. This might resulted to the future of Africa and Asia will be brighter that darker.

The concept of hereditary genetics distinguish an individual or a group of individual from the other is a reputational way that triggers a misconception, and incorrect. The world outlook, and paradigm of the target speech community or an individual is not a consequence of hereditary genetics, rather this can be considered as a misconception of genetics.

Scientists do not agree about whether race is biologically real. 99.9% of the DNA between any two humans is identical. When genetics look at the variation portion of human DNA (0.1%) they find:

1. 95.7% of differences are between people of the same race,
2. 4.3% of differences are between peoples of different races.

Skin color changes continuously as one moves away from the equator. But there is more variation in skin color across race than within races. Let adapt this concept to linguistics. A group of people born by chance in the same or nearly the same geographical location might share same language as a vernacular language. These speech communities are different from other target community speak another language. More explicitly 99.9% of the DNA between these two different speech communities are exactly the same. As mentioned above not only 99.9% of the DNA of two human is identical. But also, more than 99% of language of the world share same consonants and vowels. The phoneme chart of most language of the world is almost the same. Therefore, ethnic conflict in different part of the world particularly Africa and Asia has no theoretical and practical reasons. In another word ethnic conflict among two races has no reason and a conflict between groups those share 99.9% of the DNA and 99% of the linguistic characteristics.

Regarding identity there are two type of identity: permanent and temporary identity. Permanent contains family, and a group of people live in the same or nearly the same area share same assets. Whereas, temporary identity composed of power, money and minor affairs faces in day to day activity. To create harmony among the target speech community, the priority ought to given to the permanent than temporary. It is true that in a certain social context if natural disaster happen regardless of language, religion, "ethnic" background it will harm all equally. Climate change, El-nino, flood, fire, and tsunami, happened to all equally. Therefore, social context is among criteria for social genetics.

Currently, in developed countries such as US and Europe "natives" are standing against "non-natives". Such thinking ought to stop and come to an end. To answer the question whom America belong? Red Indian? or Mexicans? or African? It is better to look at

things from social genetics and sociolinguistics. Currently, dwellers of USA share the same language and social values. This does not mean that, those doesn't share same language with them but live in US is genetically unlike. If some incident happen to USA, all share equally.

Since the source of human being is East Africa particularly Ethiopia, the concept of languages are from same mother source ought to be introduced to the world. Because the issue of racism is a potential threat to the world including USA and Europe. If it is not managed well this might be the cause or immediate cause for the world war III. Different speech community ought to make sense of within-group variation if they are to understand between group variations. Because, these two "different" speech communities are genetically, linguistically and gnomically a like and share similar sets of within-group differences

5. REFERENCES

1. Andreychik, M. R., & Gill, M. J. (2014). Do natural kind beliefs about social groups contribute to prejudice? Distinguishing bio-somatic essentialism from bio-behavioral essentialism, and both of these from entitativity.Group Processes & Intergroup Relations, 18(4), 454–474
2. Crawford, N. G., Kelly, D. E., Hansen, M. E. B., Beltrame, M. H., Fan, S., Bowman, S. L.,…Tishkoff, S. A. (2017). Loci associated with skin pigmentation identified in African populations.Science, 358(6365), 1–25. https://doi.org/10.1126/science.aan8433
3. Dar-Nimrod, I., & Heine, S. J. (2011). Genetic essentialism: On the deceptive determinism of DNA.Psychological Bulletin, 137(5), 800–818. https://doi.org/10.1037/a0021860
4. Donovan, B. M. (2015a). Putting humanity back into the teaching of human biology.Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences, 52,65–75. https://doi.org/10.1016/j. shpsc.2015.01.011
5. Donovan, B. M. (2015b). Reclaiming race as a topic of the U.S. biology textbook curriculum.Science Education, 99(6), 1092–1117. https://doi.org/10.1002/sce.21173
6. Doron, C.-O. (2012). Race and genealogy: Buffon and the formation of the concept of"race". E. Casetta & V. Tripodi, Making Sense of Gender, Sex, Race, and the Family, Humana. Mente Journal of Philosophical Studies, 22,75–109.
7. Donovan B.M 2019 Toward a more humane genetics education: Learning about the social and quantitative complexities of human genetic variation research could reduce racial bias in adolescent and adult populations. Science EducationPublished by Wiley Periodicals, Inc. wileyonlinelibrary.com/journal/sce.
8. Foster, M. W. (2009). Looking for race in all the wrong places: Analyzing the lack of productivity in the ongoing debate about race and genetics.Human Genetics, 126(3), 355–362. ttps://doi.org/10.1007/s00439-009-0674-1

9. Hudson, N. (1996). From“nation” to “race”: The origin of racial classification in eighteenth-century thought.Eighteenth- Century Studies, 29(3), 247–264.
10. Jackson, J. P., Jr., & Depew, D. J. (2017).Darwinism, democracy, and race: American Anthropology and evolutionary biology in the twentieth century. New York, NY: Routledge.
11. Keller, M. C. (2014). Gene×environment interaction studies have not properly controlled for potential confounders: The problem and the (simple) solution.Biological Psychiatry, 75(1), 18–24. https://doi.org/10.1016/j.biopsych.2013.09.006
12. Kimel, S. Y., Huesmann, R., Kunst, J. R., & Halperin, E. (2016). Living in a genetic world how learning about interethnic genetic similarities and differences affects peace and conflict.Personality and Social Psychology Bulletin, 42(5), 688–700.
13. Kaplan, J. M., & Winther, R. G. (2013a). Prisoners of abstraction? The theory and measure of genetic variation, and the very concept of“race”. Biological Theory, 7(4), 401–412.
14. Kaplan, J. M., & Winther, R. G. (2013b). Realism, antirealism, and conventionalism about “race”. Retrieved from http://philpapers.org/rec/KAPRAA
15. Mallon, R. (2013). Was Race thinking invented in the modern West?Studies in History and Philosophy of Science Part A, 44(1), 77–88. https://doi.org/10.1016/j.shpsa.2012.10.001
16. McWhorter J. et al 2019 Language families of the world. Virginia: colombia university press.
17. Morning, A. (2009). Toward a sociology of racial conceptualization for the 21st century.Social Forces, 87(3), 1167–1192.
18. Morning, A. J. (2011).The nature of race: How Scientists think and teach about human difference. Berkeley, CA: University of California Press.
19. Samuel L., and Wolde E.,(2015),‘Linguistic Analysis of Moribund Lexicons: Focus on Baalee Oromo’,*Journal of Science and sustainable Development (JSSD)*, VOLUME 2 ISSUE 1, 73-85.
20. Samuel L., and Wolde E., (2017) ‘Critical Analysis of the Diacritic /'/ inAfan Oromo’, *Ethiopian Journal of Social and Language Studies*, Vol. 4 No. 1
21. Samuel L. (2019). Assesment of mother toungue education at primary schools: West Shoa in focus (unpublished research).
22. Soylu, Y. N., Estrada-Villalta, S., & Adams, G. (2017). The (biological or cultural) essence of essentialism: Implications for policy support among dominant and subordinated groups.Frontiers in Psychology, 8, 900. https://doi.org/10.3389/fpsyg. 2017.00900
23. Victoria F. et al (2003). An Introduction to Language. Wadsworth: Boston: USA.
24. Williams, M. J., & Eberhardt, J. L. (2008). Biological conceptions of race and the motivation to cross racial boundaries. Journal of Personality and Social Psychology, 94(6), 1033–1047.
25. Willinsky, J. (1998). Learning to divide the world: Education at empire’s end. Minneapolis, MN: University of Minnesota Press

Websites:

26. https://www.avila.edu/_userfiles/Education/Fulbright-Hays%20Project/Educator%20Microsite/Curriculum%20Unit/Hillstock/Rwanda_Genocide_The_Impact_of_.pdf
27. https://en.wikipedia.org/wiki/Hutu#Language
28. https://en.wikipedia.org/wiki/Origins_of_Hutu,_Tutsi_and_Twa
29. https://en.wikipedia.org/wiki/Tutsi
30. https://www.thoughtco.com/location-of-conflict-tutsis-and-hutus-3554918

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A seroprevalence study of Contagious Bovine Pleuropneumonia (CBPP) and Assessment of Risk Factors on Indigenous Afar Cattle in Selected Districts of Afar Region, Afar, Ethiopia

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ABSTRACT

Contagious Bovine Pleuropneumonia CBPP) is a transboundary and economically devastating cattle disease rampant in lowland areas where majority of the country's cattle population are reared by the pastoral production system. Influenced by pastoral production system, CBPP has continued to be a productivity impedance to pastoral area settings. Studies suggested that CBPP is being prevalent in lowlands than mid and highland agro-ecologies. No matter how CBPP is a prime constraint to cattle producers in Afar region, research outputs on CBPP are unavailable compared to highland areas in the country. Thus, the objectives of the current study were to determine serological prevalence of CBPP and evaluate associated risk factors in selected districts of the region. A cross-sectional study design was conducted on local Afar cattle aged six months and above from February 2018 to January 2019 in selected Dubti, Asaita and Chifra districts, Afar region. From each randomly selected animal, 8ml blood was drawn from the jugular vein into plain vacutainer tubes. Determined by Thrusfield formula, a total of 420 serum samples were collected. Samples were labeled, packed and transported to Samara University for separation of serum and blood and sera stored at -20C. Using c-ELISA, antibodies against *Mycoplasma mycoides subspecies mycoides small colony* (MmmSc) were detected at National Veterinary Institute (NVI), Ethiopia. Data were analyzed using Stata 14.0 software. Using descriptive statistics, prevalence and frequencies were computed. Of 420 samples tested by c-ELISA, 158 samples were found to be positive for CBPP providing an overall prevalence of 37.6% with 95% CI (32.97-42.27). Of the three risk factors (age, sex and district) assessed by Chi-square ($\chi 2$), only two (age and district) were found to be associated with CBPP ($P<0.05$). Both age and district were significantly associated with the disease by bivariate logistic regression. However, only district was found to be significantly associated with CBPP by multivariate logistic regression analysis using 95 % CI and P-value less than 5%. The study addressed the current status of CBPP in the study areas to be higher, urging prompt and coordinated intervention to be set in place.

Keywords: CBPP, Cattle, Disease, Risk factors, Seroprevalence, Mycoplasma, Bacteria, Afar region

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1. INTRODUCTION

Livestock enterprises and animal production contribute significantly to the world economy, generate household income, food security, source of energy, draft power for crop cultivation or providing services, high-quality animal proteins and vitamins (meat, milk), creating job opportunities, manure, raw materials (hides and skins), social assets, cultural and environmental values, and sustain livelihoods (Perry *et al*., 2003, Bonnet *et al*., 2011; Naqvi and Sejian, 2011; Metaferia *et al*., 2011).

Cattle are generally regarded as the most important domestic livestock species in the world (Rushton 2009). The major biological constraints contributing to low productivity of cattle include the low genetic potential of animals, poor nutrition and prevailing diseases (Belay *et al*., 2012a; Belay *et al*., 2012b). Among the prevalent cattle diseases, foot and mouth disease (FMD), contagious bovine pleuropneumonia (CBPP), lumpy skin disease, trypanosomiasis, external parasites and tick-borne diseases are main animal health problems in the animal health context.

CBPP is one of the most important transboundary cattle diseases through its clinical effects on animals and far more severe than foot and mouth disease (FMD) (Nicholas, *et al*., 2008). Currently, it is recognized as a priority transboundary disease and has thus been categorized as the only bacterial disease in the OIE list A diseases (OIE, 2000).

Historically, CBPP has been known to occur in Europe since the 16th century though it gained a worldwide distribution only during the second half of the 19th century due to increased international trade in live cattle. In Africa, the disease was introduced first into South Africa in 1854 through importations of cattle from the Netherlands from where the disease spread to other African countries. CBPP has been eradicated from Australia, most parts of Europe, Asian and America) by the beginning of the 20th century through the application of restrictions to the movement of cattle and application of test and slaughter policies combined with compensation for livestock keepers (Andrews *et al*., 2004). However, CBPP is yet present in other regions of the world including Middle East, parts of Asia and until very recently, Southern Europe. Eradication policies are difficult to apply in most developing countries because of pastoralism, lack of economic resources and fragmented veterinary services (Neiman *et al*., 2009; Sacchini *et al*., 2012). The disease is endemic to parts of Africa and in almost all African countries and is a notifiable endemic disease (Radiostits *et al*. 2006) and considered to be the most damaging threat to the livestock industry in the region. The Pan African Program for the Control of Epizootics (PACE) identified CBPP as the second most important transboundary disease in Africa after Rinderpest (Tambi *et al*., 2006). Following the eradication of Rinderpest from Africa, CBPP has become the disease of prime concern in terms of epizootics affecting cattle in the continent (Amanfu, 2009).

CBPP is a highly infectious, acute, subacute or chronic septicemic cattle disease affecting lungs, pleura and occasionally joints in calves (Tambi *et al*., 2006; Radostits *et al*., 1994) caused by *Mycoplasma mycoides subspecies mycoides* small colony (OIE, 2008; Terlaak, 1992; Taylor *et al*., 1992)**.** The principal transmission route of CBPP is

through inhalation of infective droplets from active animals or carrier cases of the disease (Radiostits *et al*., 2008) and the disease is clinically characterized by anorexia, fever, weakness, emaciation, dyspnoea, polypnoea, cough and nasal discharges (OIÈ, 2002; Egwu *et al.,* 1996). Current advanced diagnostic techniques available for the diagnosis of CBPP include clinical signs, pathologic lesions (Pleurisy, lung hepatization), identification and isolation of the agent (the bacterium), immunoblotting, serology and PCR techniques (Goffe and Thiaucourt, 1998).

CBPP causes reduced productivity, disrupts local market system, international trade and commerce, exacerbate poverty, causes pain and suffering to animals, disrupts food supplies system, retards genetic improvement and inhibits sustainable investment in livestock production, increases disease control costs, reduces draft power, causes direct losses (deaths, stunting, reduced fertility, and changes in herd structure), added labour costs and profit losses due to denied access to better markets (Thornton, 2010; FAO 2009; Rushton, 2009; Tambi *et al*., 2006).

CBPP status in Ethiopia

Historically, there is no established document as to when and how the disease exactly entered Ethiopia (Amanfu, 2009). Economically viewed, CBPP is one of the most important diseases in Africa being widespread in West, Central and Eastern parts of the continent (Thomson, 2005) and the disease is endemic in Eastern Africa, including Rwanda, Burundi, Tanzania, Sudan, Ethiopia and Uganda (Lesnoff *et al*., 2002). According to OIE (2008), the highest number of outbreaks reported in 20 African countries (2006) was recorded in Ethiopia. An economic loss analysis study conducted by Tambi *et al*. (2006) in 10 African countries including, Ethiopia has estimated an annual loss of €14, 987,000 million attributed to CBPP threat.

In Ethiopia, according to reports of various outbreaks, national serosurveillance and research results from 1997 to 2010, CBPP was found to be present in almost all regional states (Tuli, 2010). CBPP has been reported in different regions of Ethiopia with an overall seroprevalence like 7.13% in Afar, 1.29% in Amhara, 12.05% in Benishangul Gumuz, 19.72% in Gambella, 5.17% in Oromia, 5.44% in Southern Nations Nationalities and People (SNNP), 0.9% in Somali, and 6.11% in Tigray in the year of 2004 (Gulima, 2011). In Ethiopia, CBPP is considered as one of the most important cattle diseases and continued to be an important impediment to livestock development in the country (Atnafie *et al*., 2015; Amanfu, 2009; Ministry of Agriculture (MOA), 2003). Studies were undertaken on CBPP so far revealing the existence of the disease in different parts of Ethiopia with prevalence ranging from 0.4% (from the bull at finishing phase for export in East Shewa zone that brought from Borena pastoral area) (Alemayehu *et al.*, 2015) to 96% in Western Gojjam (Yigezu and Roger, 1997).

CBPP in arid and semi-arid areas: The case of Afar region

Influenced by mobile pastoralism, CBPP is one of the most dominant diseases in arid and semi-arid areas in eastern, northeastern and southeastern parts of Ethiopia (Tegegne *et al*., 2009). As studies suggest, CBPP is a great plague and continued to devastate cattle on which many people are dependent in lowland areas (Ministry of Agriculture (MOA), 2003). The persistence of CBPP in pastoral areas could be

attributed to migratory lifestyle of pastoralists leading in turn for uncontrolled movement of cattle with continuous mixing at grazing fields, watering points and difficulty in accessing vaccination services (Amanfu, 2009). A regional survey reported by Gulima (2011) indicated the prevalence of CBPP to be 7.13% in the Afar region.

By implication, CBPP remained to be a major threat to the country as 40% of livestock populations are kept under the pastoral lowland production systems (CSA, 2011). Furthermore, a significantly higher seroprevalence was found in animals in lowland areas than highland and mid highland agroecologies (Mamo, 2016). CBPP is reported to be a major constraint to cattle production in arid and semi-arid pastoral areas (Kairu-Wanyoike *et al*., 2013), affecting livelihoods of many more thousand households. Furthermore, studies suggested that CBPP is prevalent in lowland areas than mid and highland agroecologies. No matter how CBPP is a prime constraint to cattle producers in Afar region in general and stated study districts in particular, research outputs on CBPP are unavailable in Afar region as compared to highland areas of Ethiopia. Therefore, the objectives of the current study were to determine prevalence of CBPP in selected districts in the region and evaluate risk factors associated with the disease.

2. MATERIALS AND METHODS

2.1 Study areas

The study was conducted from February 2018 to January 2019 in three selected districts of Afar region, namely Dubti, Asaita and Chifra where the entire study districts are situated in Zone one of the region. Afar region is one of the nine federal states of Ethiopia located in the northeastern part of the country. The region is geographically located between 39º34’ and 42º28’ East Longitude and 8º49’and 14º30’North Latitude. The region comprises 5 administrative zones, 32 districts and 331 kebeles, 28 towns, and 401 rural and urban kebeles (CSA, 2008).

2.2 Study design

A cross-sectional study design was applied to determine the prevalence of CBPP and associated risk factors over the selected study sites.

2.3 Study population

All indigenous Afar cattle aged 6months and above reared by pastorals and agropastoral in the selected sites were used for the study.

2.4 Sampling technique and sample size determination

Both randomized and purposive sampling techniques were applied for the selection of study animals (cattle) and study areas. While study zone, districts and kebeles were chosen purposively, households and study units/individual cattle were selected using a simple random sampling technique. As no previous study conducted on CBPP in cattle found in the selected areas, the present study has considered 50% expected prevalence, 95% confidence level and 5% absolute precision or marginal error. Based on these variables, the total number of animals to be included in the study got determined using the Thrusfield (2007) formula.

$$n = \frac{1.96^2 \times P_{exp} \times (1-P_{exp})}{d^2}$$

Where n= required sample size, d= desired absolute precision, P_{exp}= expected prevalence (50%).

Based on the formula, the total sample size was computed to be 384 cattle to be selected of the three districts. To minimize chance and increase precision of the outcome, the total number of study animals was increased to 420. Proportionally, a total of 128, 130, and 162 were collected from Asaita, Dubti and Chifra districts, respectively mainly based on density of cattle population and accessibility of kebeles in the study districts. Based on age animals were grouped into three categories namely (1) young (1 to 2 years), (2) adult (3 to 8 years), and (3) old (>8 years) according to Gatenby (1991) and Abera *et al*. (2010).

2.5 Methodology

A total of 420 sera samples each amounting to 8-10 ml of whole blood was collected from the jugular vein of cattle into disposable plain vacutainer tubes using 21 Gauge needle. Just following collection, blood sample containing vacutainer tubes were labeled and transported to the laboratory and kept overnight at room temperature to allow the blood clot. Correspondingly, each sample was identified along with age, study district and sex. Coded sera were transferred to cryogenic vials and stored in -20°C refrigerator at Samara University Veterinary Medicine Microbiology Laboratory to the time of transportation to National Veterinary Institute (NVI) for sera analysis.

2.6 Competitive Enzyme Linked Immunosorbent Assay (c-ELISA)

As recommended by OIE for CBPP test, c-ELISA technique was applied at National Veterinary Institute (NVI) serology laboratory, based on the manufacturer's instruction (CIRAD-EMVT, France) (Amanfu et *al*., 2000). In principle, c-ELISA test is based on a monoclonal anti-MmmSC antibody named Mab 177/5 (OIE, 2014). Technically, using microplates precoated with MmmSC purified lysate, test samples were premixed with the specific monoclonal antibody Mab117/5 in a separate plate and the mix was transferred to the precoated microplate with MmmSC antigen. Any MmmSC specific antibodies present in the sample will form an immune complex with MmmSC antigen coated on the microplate competing with Mab117/5 for the specific epitope. Following washing of unbounded material, an anti-mouse antibody-enzyme conjugate was added. In the presence of an immune complex between MmmSC antigen and antibodies from the sample, Mab117/5 cannot bind to its specific epitope and the conjugate is blocked from binding to Mab117/5. On the other hand, in the absence of MmmSC antibodies in the test sample, Mab117/5 can bind to its specific epitope and the conjugate is free to bind to Mab 117/5. The unbound conjugate was washed away and the enzyme substrate, Tetra methyl Benzedrine (TMB) was added. In the presence of the enzyme, the substrate is oxidized and leading to the development of blue color but yellow color will develop after adding the stop solution. Subsequent color development was inversely proportional to the amount of anti-MmmSC antibodies in the test sample. Eventually, optical density (OD) of individual reaction was measured at 450 nm using

a plate reader and samples having OD values greater 50 or more were considered positive.

3. Data management and analysis

Data were coded and fed into Microsoft Excel for further statistical analysis. Applying Stata version 14.0, (StataCorp, Texas, USA, 2015) descriptive statistics were computed to calculate the overall prevalence of CBPP and related figures associated with risk factors. Association between risk factors and disease positivity was assessed using Chi-square ($\chi 2$). Bivariate logistic regression was computed to estimate the magnitude of association between risk factors and the disease. Risk factors having significant association with the disease were further analyzed by multivariate logistic regression analysis using 95% confidence level (CI) and P-value less than 0.05.

3.1 Descriptive statistics

Descriptive statistics were employed to calculate the proportion of risk factors (season, sex, age and district) to test result as summarized in Table 1. The total collected sera were tested using c-ELISA. Accordingly, the total number of positive samples for each variable category with its respective percentage has been computed and summarized in Table 1.

Table 1: Summary of descriptive statistics

Variable		Samples tested	cELISA test result		Percentage (%)
			Negative(n)	Positive (n)	
Sex					
	Female	**377**	**234**	**143**	34.0
	Male	**43**	**28**	**15**	3.6
District					
	Dubti	130	89	41	9.8
	Asaita	128	59	69	16.4
	Chifra	162	114	48	11.4
Age					
	Young	48	29	19	4.5
	Adult	249	170	79	18.8
	Old	123	63	60	14.3

Of all serum samples tested (n=420) by c-ELISA in search of *Mycoplasma mycoides subspecies mycoides* small *colony type* (MmmSc) specific antibody, 158 serum samples were found to possess MmmSc specific antibody. Hence, the overall seroprevalence of CBPP over the three study districts was computed to be 37.6% with 95% CI (32.97-42.27).

Table 2: Overall prevalence of CBPP by cELISA

Samples tested	Negative Samples	Positive Samples	Prevalence (%)	95% Confidence Interval (%)
420	262	158	37.62	32.97 - 42.27

Association and bivariate logistic regression analysis

The association between the disease and risk factors **(**age, sex and district**)** was computed by Chi-Square (χ^2). As a result, only two risk factors (age, P<0.05:0.036) and district, P<0.05:0.000) were found associated with CBPP occurrence. However, sex has no significant association with CBPP occurrence (P>0.05: 0.696). Further, using 95% CI and P<0.05, bivariate logistic regression analysis was computed for age and district to estimate the magnitude of association (Crude Odds Ratio=COR) with the disease (Table 3).

Multivariate logistic regression analysis

Independently analyzed by binary logistic regression, age and district were found associated significantly with the disease. To compute the real significant contribution of associated risk factors without compounding effect, multivariate logistic regression analysis was computed with 95% CI and P<0.05 and only district has been associated significantly (P<0.05:0.000) with the disease but age has no significant impact on CBPP occurrence among the different age groups. Taking Dubti district as the reference category, those cattle found in Asaita district were 2.54 times more likely at risk of acquiring CBPP as compared to those animals found in Dubti district.

Table 3: Bivariate and multivariate logistic regression analyses

Variable	cELISA test result		Binary logistic regression analysis		Multivariate logistic regression analysis	
	Negative	**Positive**	**COR(95%CI)**	**P-value**	**AOR (95%CI)**	**P-value**
Age						
Young	**29**	**19**	**0.6878 (0.349-1.355)**	0.280	0.923(0.429 - 1.981)	**0.837**
Adult	**170**	**79**	**0.488(0.313 -0.759)**	0.001	0.607(0.362-1.0173)	**0.058**
Old	**63**	**60**	**1**		**1**	**0**
District						
Dubti	**89**	**41**	**1**		**1**	**0**
Asaita	**59**	**69**	**2.537 (1.528-4.217)**	0.000	2.509 (1.505- 4.185)	**0.000**
Chifra	**114**	**48**	**0.9139(0.554-1.508)**	0.725	1.089 (0.619-1.913)	**0.768**

Based on the magnitude of the current overall prevalence observed (37.6%), over the three selected Afar districts, CBPP could be considered as a prime concern for cattle health and productivity in the particular study districts as well in Afar region. It could also be inferred that CBPP is more prevalent in Asaita district (16.4%) as compared to Dubti (9.8%) and Chifra (11.4%) districts.

In Ethiopia, the prevalence of CBPP varies from the lowest prevalence of 0.4% reported by Alemayehu *et al*., 2014 in Borena Zone, Ermiyas *et al*., 2014 in Export quarantine centre of Adama by Dele *et al*. (2014) in Export quarantine centre of Adama to the highest CBPP prevalence in Ethiopia (96%) reported by Yigezu and Roger (1997) from Western Gojam.

The prevalence of CBPP among African countries also varies. The prevalence of CBPP in 10 African countries included: 8.1% in Sudan (McDermott *et al.*, 1987), 0.29% in Nigeria (Aliyu, *et al.*, 2000), 2.8% in Kenya (Wanyoike, 1999), 4% in Ethiopia (Fikru,

2001), 2.9% in Burkina Faso (Kane, 2002), 5.4% in Mauritania (Kane, 2002), 8.1% in Mali (Sery *et al*., 2014), 21.05% in Guinea (Soromou *et al*., 2014), 66% in the Gambia (Mbengue *et al*., 2013) and 0.43% in Senegal (Mbengue *et al*., 2013). According to reports, the highest CBPP prevalence (96%) was recorded in Ethiopia followed by Gambia (66%) and thirdly Mali (21.05%).

Similarly, the magnitude of CBPP prevalence has been so variable in different parts of Ethiopia. According to reports of various outbreaks, national serological surveillance and research results from 1997 to 2010, CBPP has been confirmed to be present in almost all regional states of Ethiopia (Tuli, 2010).

Compared to the current finding over the study districts (37.6%), other studies have reported lower CBPP prevalence: 5.1%. by Roger and Yigezu (1995) in North Omo,5.1% by Issa (2004) from Borena pastoral areas reported, a 10.3% by Mekonnen (2004) in Somali region, 4% by Kassaye and Molla (2012) during a period of 2010-2011 from export quarantine centers in and around Adama, 8.7% by Gedlu (2004) in Bishoftu, 9.4% by Ahmed (2004) in Borena zone and 9.5% by Kassaye and Molla (2013) on Adam export quarantine center, 10% by Molla and Delil (2014) from Dasench district of South Omo, 11.0% by Teshale et *al*. (2015) from Southern Tigray, 10.3% by Gizaw (2016) from Shinille zone of the Somali region, 28.5% by Daniel *et al*. (2016) from Western Oromia, 31.8% by Tolesa *et al*. (2105) from Amaro district, SNNP, 28% by Regassa (2001) from Bodji district of Western Wollega, 32.5 by Desta (1998) from Western Ethiopia, 9.1% by Gashaw (1998) from Northwest Ethiopia, 7.8% by Biruhtesfa *et al*. (2015) on Abattoirs at Bishoftu and Export Oriented Feedlots Around Adam, and 8.1% by Mamo (2016) from Gimbo district, SNNP.

However, the current finding was found to be in a close agreement with other reports including Gedlu (2004) who reported 39% prevalence from Somali Regional State. Similarly, the current report has agreed with the report of Desta (1998) who reported 32.5% in Western Ethiopia.

However, just based on magnitude, the current finding was lower some other prevalence reports: From Western Gojam and Awi Zone, Gashaw (1998) has reported 66.3%) in Banja district, 41.7% in Dangila district and 33.3% in Denbecha district. Similarly, Dejene (1996) has reported 56% CBPP prevalence in North Omo, Desta (1998) has reported a prevalence of 48% in Ilu Ababor and Wollega (Western Ethiopia), Roger and Yigezu (1995) reported 46% CBPP prevalence in Konso of SNNP, Yigezu and Roger (1997) reported 74 % CBPP prevalence in Borena Zone and finally 75% prevalence of CBPP in Western Wollega zone.

As indicated by different scholars, the prevalence of CBPP varies in Ethiopia as well as the across the African continent in general. The variation of findings on CBPP seroprevalence in different parts of Ethiopia could be due to variation in the temporal and spatial distribution of disease agroecological system, animal management (husbandry practices), biological or breed difference, communal grazing areas, production system, cattle population density, herd size, number of examined animals, livestock movement and sensitivity of serological tests used to evaluate seroprevalence (Daniel *et al*., 2016; OIE, 2014; Ebisa *et al*., 2015).

In the current study, district, age and sex were considered as risk factors. Accordingly, their association and strength of association with the disease were statistically evaluated. Based on the computations found, district was found to have a statistically significant association (P=0.000, χ^2 = 20.924) with the disease. Similarly, the age of animals was also significantly associated (P=0.006, χ^2 = 100.292) with disease seropositivity. On the other hand, sex (P=0.696, χ^2 = 0.153) had no significant association with the disease.

The current study has revealed the seroprevalence of CBPP at districts to be 9.8%, 16.4% and 11.4% for Dubti, Asaita and Chifra, respectively, indicating differences with statistically significant variation (P<= 0.05; 0.000) in the prevalence of antibodies among the districts. Other studies have reported similar findings (Tesfaye,2016); Tadese,2014; Daniel *et al*.,2016). The significant variation among study districts might be attributed to the presence of large number of livestock population within the districts, the presence of communal grazing and watering areas, degree of confinement/crowding, husbandry practices, agroecological difference and degree of cattle movements (OIE, 2014).

Referring to Gatenby (1991) and Abera *et al*. (2010), the age of study animals was divided into three groups: Young, Adult and Old. The current study has indicated infection rates of 4.5%, 18.8%, and 14.3% for young, adult and old age groups, respectively. Unlike sex, age had statistically significant association (P=0.006, $\chi 2$ = 100.292) with CBPP occurrence. However, multivariate logistic regression analysis showed that the significant association of age with the disease found by bivariate logistic regression analysis was found to be nonsignificant (**Table 3**) implying that age has real no contribution to CBPP occurrence and rather was confounded.

In the current study, the prevalence of CBPP in young animals was lower than both adult and old animals. In adult animals, the prevalence was observed to be higher than young animals. The higher prevalence in adults would be attributed to the fact that young animals do not move far away from houses; therefore, there is less chance to come into contact with infected animals. Besides, Masiga, Domenech and Windsor (1995) reported that young animals are more susceptible to acute forms of CBPP than adult cattle and thus acutely infected young animals may die of CBPP and not be available for testing. The current finding agrees with reports of Bashiruddin *et al.* (2005) who reported that with age infection resistance could also vary. According to Bashiruddin *et al*. (2005) animals, less than 3 years of age are less resistant to CBPP by experimental studies. In two separate experiments, it was shown that cattle over 3 years of age were more resistant to CBPP infection than younger animals. Besides, the present result was also in close agreement with previous study reported by Swai *et al*. (2013) and Matua-Alumira *et al*. (2006) who reported that seropositivity in adults was a bit higher than that in young animals. However, the study made by Kassaye and Molla (2012) and Andrew *et al*. (2004) contradicted with Bashiruddin *et al*. (2005) in which both described as calves were less positive to CBPP seroprevalence.

The lower prevalence of CBPP in older cattle as compared to adults would probably be associated with decreased immunity and resistance of older animals. Conversely,

the prevalence of CBPP in older cattle was higher as compared to young animals. This finding agrees with the claim that CBPP is a disease of older animals (Andrews *et al*. 2004). This might be attributed to long time exposure and life span of the older animals than the younger ones and the persistency of sequestrum for a long period of time in CBPP recovered animals.

In the current study, infection rate by sex was computed to be 3.6% and 34.0% for male and female respectively. However, there was no statistically significant difference with sex (P=0.696, χ^2 = 0.153). No matter how there was no statistically significant difference ($p > 0.05$), the higher prevalence of CBPP in female cattle agrees with Schnier *et al*. (2006) who reported a significantly higher prevalence in female animals. Similarly, the current finding agrees with the report of Tesfaye (2016). Similarly, Teshale *et al*. (2015) has also reported a difference in the prevalence of CBPP between male and female. The variation in the prevalence between male and female animals could be due to sampling error or the nonproportionality of samples collected, level of stress and degree of contact with young susceptible young/calves. However, the insignificant ($P<0.05$) difference of seroprevalence between sex may be due to similar exposure of animals to the disease since the disease is contagious that all animals in the herd can be affected and that a single diseased animal can serve as a continuous source of infection to the herd. The disease is mainly transmitted from animal to animal in aerosols. This organism occurs in saliva, urine, fetal membranes and uterine discharges (Radostits *et al*., 2008). This could play a great role in the uniformity of infection in both sexes.

4. CONCLUSION AND RECOMMENDATION

The current study has provided founding evidence against CBPP in Afar region. The overall magnitude of seroprevalence of the disease over the three selected districts suggested higher prevalence indicating higher level of economic challenge posed on cattle owners'. Furthermore, the study has identified contributory risk factors for disease occurrence. Of the three risk factors evaluated, age and study sites (districts) have indicated to have a significant association with seropositivity of the disease. In conclusion, the study findings strongly urge a prompted and coordinated intervention to be taken forward.

5. REFERENCES

1. Abera M, Mohammed T, Abebe R, Aragaw K, Bekele J. "Survey of ixodid ticks in domestic ruminants in Bedelle district, Southwestern Ethiopia," Tropical Animal Health and Production, vol. 42, no. 8, pp. 1677–1683, 2010.
2. Ahmed I. 'Epidemiological study of contagious bovine pleuropneumonia in Borana pastoral areas using complement fixation test and competitive enzyme-linked immunosorbent assay', Thesis for degree of Master of Veterinary Epidemiology, Faculty of Veterinary Medicine, University of Addis Ababa, Addis Ababa, 2004.
3. Alemayehu G, Leta S, Hailu B. Sero-prevalence of contagious bovine pleuropneumonia (CBPP) in bulls originated from Borena pastoral area of Southern Ethiopia. Trop Anim Healt prod (2015) 47(5):983–7. doi:10.1007/ s11250-015-0820-9

4. Alemayehu G, Leta S, Hailu B. "Sero-prevalence of Contagious Bovine Pleuropneumonia (CBPP) in bulls originated from Borena pastoral area of Southern Ethiopia," Tropical Animal Health and Production, vol. 2, no. 6, pp. 213–217, 2014.
5. AliyuMM, ObiTU, OladosuLA, Egwu GO, AmehJA. The use of competitive enzyme linked immunosorbent assay in combination with abattoir survey for CBPP surveillance in Nigeria. Trop. Vet Medicine. 2000; 21: 35-41.
6. Amanfu W. Contagious bovine pleuropneumonia (lungsickness) in Africa. Onderstepoort J Vet Res 76: 2009, 13–7. doi:10.4102/ojvr.v76i1.55
7. Amanfu W, Sediadie S, Masupu KV, Raborokgwe V, Benkirane A, Geiger R, Thiaucourt F. Comparison between c-ELISA and CFT in detecting antibodies to Mycoplasma mycoidesmycoides biotype SC in cattle affected by CBPP in Botswana. Annals of the New York Academy of Science, 916: 364-369. 2000.
8. Andrews AH, Blowey RW, Boyd H, Eddy RG. Bovine Medicine Diseases and Husbandry of Cattle, 2 ed., (Blackwell publishing, A nd Gay, ustralia), 2004, pp: 868-874.
9. AtnafieB, GobaH, Sorri H, KasayeS. Sero-prevalence of contagious bovine pleuropneumonia in abattoirs at Bishoftu and export oriented feedlots around Adama. Glob Vet (2015) 15(3):321–4.
10. Bashiruddin B, de Santis P, Persson A, Ball H , Regalla J. "Detection of Mycoplasma mycoides subspecies mycoides SC in bovine lung and lymph node tissues by culture, sandwich ELISA and polymerase chain reaction systems," Research in Veterinary Science, vol. 78, no. 3, pp. 199–205, 2005.
11. Belay D, Yisehak K, Janssens GPJ. Survey of Major Diseases Affecting Dairy Cattle in Jimma Town, Oromia, Ethiopia. Global Veterinaria, 8: 2012a, 62-66.
12. Belay D, Yisehak K, Janssens,. Productive and Reproductive Performance of Zebu X Holstein-Friesian Crossbred Dairy Cows in Jimma Town, Oromia, Ethiopia. Global Veterinaria, 8:67-72. 2012b
13. Berhanu A. Primary Animal Health care in Ethiopia. In: Primary Animal Health in the 21st century: Shaping the rules, Polices and Institutions. Addis Ababa, Ethiopia, 2008: 1-4.
14. Biruhtesfa A, Henok G, Hundera S, Surafel K. "Seroprevalence of contagious bovine pleuropneumonia in abattoirs at Bishofu and export oriented feedlots around Adama, Ethiopia," GlobalVeterinaria, vol. 15, no. 3, pp. 321–324, 2015.
15. Bonnet P, Lancelot R, Seegers H, Martinez D. World organization for animal health. Seventy ninth General session World Assembly, Paris 22-27 May 2011.
16. Central Statistical Agency of Ethiopia. Statistical report of national livestock population. Addis Ababa, Ethiopia, 2014.
17. CSA (Central Statistical Authority). Summary and statistical report of the 2007. Population and Housing Census. Addis Ababa, Ethiopia, 2008.
18. CSA(Central Statistical Authority).Central Statistics Agency. Addis Ababa, Ethiopia, 2011.
19. Daniel G, Abdurahaman M, Tuli G, Deresa B. "Contagious bovine pleuropneumonia: Seroprevalence and risk factors in Western Oromia, Ethiopia," Onderstepoort Journal of Veterinary Research, vol. 83, no. 1, article no. a958, 2016.
20. Dejene W. 'Contagious bovine pleuropneumonia (CBPP): Prevalence and evaluation of post-vaccination immune response (North Omo, Konso and Dirashe Regions/Ethiopia)',

Thesis for degree of Doctor of Veterinary Medicine, Faculty of Veterinary Medicine, Addis Ababa University, Addis Ababa, Ethiopia, 1996.

21. Dele E, Afera B, Kebede E, Awol N, Hadush B. Seroprevalence of trade hampering livestock diseases in animals originated from Borana at export quarantine centers in Adama, Central Ethiopia. Afr J Bas Appl Sci (2014) 6(2):30–6.
22. Desta B.'Sero-epidemiological investigation of CBPP in Ilu Ababor and Wellega (western Ethiopia)', Thesis for degree of Doctor of Veterinary Medicine, Faculty of Veterinary Medicine, University of Addis Ababa, Addis Ababa,1998.
23. Ebisa T, Hirpa H, Aklilu F. Study on seroprevalence and risk factors contagious bovine pleuropneumonia in southern nation and nationality people of Ethiopia regional state in Amaro special district. *Sci Technol Arts Res J* (2015) 4(4):106–12. doi:10.4314/star.v4i4.15
24. Egwu G.O., Nicholas R.A.J., Ameh J.A., Bashiruddin J.B. Contagious bovine pleuropneumonia (CBPP): an update. Vet. Bull., 66, (1996). 875-888.
25. Erimiyas D, Berihun A, Etsay K, Nesibu A, Birhanu H. "Seroprevalence of trade hampering livestock diseases in animals originated from borana at export quarantine centers in Adama, Central Ethiopia," African journal of basic & applied sciences, vol. 6, no. 2, pp. 30–36, 2014.
26. FAO. The state of food and agriculture. Livestock in the balance. FAO, Rome, 2009.
27. Fikru R. Herd prevalence of CBPP, bovine tuberculosis and Dictyocaulosis in Budju woreda, West Wellega. (DVM thesis). Addis Ababa University, Faculty of Veterinary Medicine, Debre zeit, Ethiopia, 2001.
28. Gashaw T.'Epidemiological survey of CBPP in Awi and Western Gojjam zone of Amhara Region and comparison of CFT and C-ELISA for the diagnosis of CBPP', Thesis for degree of Master of Veterinary Epidemiology, Faculty of Veterinary Medicine, Addis Ababa University and Freie Universität, Berlin. 1998.
29. Gatenby R.The Tropical Agriculture, McMillan Education, London, UK. 1991.
30. Gedlu M.G. 'Serological, clinical and participatory epidemiological survey of CBPP in Somali Region', Thesis for degree of Master of Veterinary Epidemiology, Faculty of Veterinary Medicine, University of Addis Ababa, Addis Ababa, 2004.
31. Gizaw MM. Serological, Clinical and Participatory Epidemiological Survey of Contagious Bovine Pleuropneumonia in Somali Region. MSc Thesis, Addis Ababa University, Ethiopia (2016).
32. Goffe C, Thiaucourt F. A competitive ELISA for the specific diagnosis of contagious bovine pleuropneumonia (CBPP). Vet. Microbial, 60: (1998)179-191.
33. Gulima D. "Disease reporting presentation on VACNADA Project closes out workshop," in CBPP in Ethiopia, p. 27, 5th-7th edition. 2011.
34. Issa A. Epidemiological study of contagious bovine pleuropneumonia in Borena pastoral area using Complement fixation test and Competitive enzyme-linked immunosorbent assay (ELISA). (MSc thesis). Addis Ababa University, Faculty of Veterinary Medicine, Debre zeit, Ethiopia, 2004.
35. Kairu-Wanyoike S.W, Kaitibie S, Taylor NM, Gitau GK, Heffernan C, Schnierd C, Kiara H, Taracha E, McKeever D. Exploring farmer preferences for contagious. Bovinepleuropneumonia vaccination: a case study of Narok district of Kenya. PREVET, http://dx.doi.org/10.1016 /*j.prevetmed.* 2013.02.013.

36. Kane M. Etude historique sur la péripneumonie contagieuse bovine au Burkina Faso, Côte d'Ivoire, Guinee, Mali, Mauritanie, Niger et Sénégal. Consultancy report produced for the African Union Interafrican Bureau for Animal Resources-Pan African Programme for the Control of Epizootics. AU/IBAR-PACE, Nairob. 2002.
37. Kassaye D, Molla W. Seroprevalence of contagious bovine pleuropneumonia at export quarantine centers in and around Adama, Ethiopia. Trop. Anim. Health. Prod. 45(1): (2012) :275-9.
38. Kassaye D, Molla W. 'Seroprevalence of contagious bovine pleuropneumonia at export quarantine centers in and around Adama, Ethiopia', Tropical Animal Health and Production 45, (2013) :275–279.
39. Lesnoff M, Laval G, Bonnet P, Sintayehu A, Workalemahu A and Kifle D, Armelle P, Lancelot R, Thiaucourt F. Within-herd spread of Contagious Bovine Pleuropneumonia in Ethiopian highlands. Prev. Vet. Med., 64 (2004): 27 – 40.
40. Mamo Y. Seroprevalence and Associated Risk Factor of Contagious Bovine Pleuropneumonia in Gimbo District Keffa Zone Southwest Ethiopia. MSc Thesis, College of Agriculture and Veterinary Medicine, Jimma University, Jimma (2016).
41. Matua-Alumira RW, Ng'ang'a Z, Kiara H, Matere C, Mbithi F, Mwirigi M, et al. 'The prevalence of contagious bovine pleuropneumonia (CBPP) in cattle under different production systems in Kajiado district, Kenya', Proceedings of the 11thInternational Symposium on Veterinary Epidemiology and Economics, August 06–11, 2006, Cairns, Australia
42. Mbengue MB, LO FT, Diallo AM, LO MM, Diop M, Samb Y, Diouf M, Daffeh K. Thiongane Y.. Re-emergence of pleuropneumonia contagious bovine in the Gambia. American Journal of Research Communication, 2013, 1(3): 181-189} www.usajournals.com, ISSN: 2325-4076.
43. McDermott JJ, Deng KA, Jayatileka TN, and El-Jack MA. A cross-sectional cattle disease study in Kongor Rural Council, southern Sudan. I. Prevalence estimates and age,sex and breed associations for brucellosis and contagious bovine pleuropneumonia. Prev.vet. Med., 5: (1987) 111-123.
44. Mekonnen, G., G. 2004. Serological, Clinical and Participatory Epidemiological Survey of Contagious Bovine Pleuropneumonia in Somali Region, Ethiopia (MSC thesis). Addis Ababa University, Faculty of Veterinary Medicine, Debre zeit, Ethiopia.
45. Metaferia F, Cherenet T, Gelan A, Abnet F, Tesfay A, Ali JA, Gulilat W.. A Review to Improve Estimation of Livestock Contribution to the National GDP. Ministry of Finance and Economic Development and Ministry of Agriculture, Addia Ababa, Ethiopia, 2011.
46. Ministry of Agriculture (MOA). Monthly Animal Health Status Report. Addis Ababa: Ministry of Agriculture Veterinary Services, Epidemiology Unit (2003).
47. Molla B, Delil F. "Mapping of major diseases and devising prevention and control regimen to common diseases in cattle and shoats in Dassenech district of South Omo Zone, South Western Ethiopia," Tropical Animal Health and Production, vol. 47, no. 1, pp. 45–51, 2014
48. Naqvi SMK, Sejian V. Global climate change: Role of livestock. Asian J. Agric. Sci. 3(1): 19-25. Nkhori PA (2004). The impact of transaction costs on the choice of cattle markets in Mahalapye district, Botswana. Dissertation submitted to University of Pretoria, Pretoria, South Africa, 2011.

49. Neiman M, Hamsten C,Schwenk JM, Bo¨lske G, Persson A. Multiplex Screening of Surface Proteins from Mycoplasma mycoides subsp. mycoides Small Colony for an Antigen Cocktail Enzyme-Linked Immunosorbent Assay, Clinical and vaccine Immunology, 16: 1665-1674. 2009.
50. Nicholas R, Ayling R, McAuliffe L. Mycoplasma diseases of ruminants, 1st edn., CABI Publishing, Wallingford, CT, 2008.
51. Office International Des Épizooties (OIE). Manual of Standards for Diagnostic Tests and Vaccines. 2002.
52. Office International des Epizooties (OIE). Terrestrial Animal Health Code (Chapter 11.8.1)., Paris, France. 2014.
53. Office Internationale des Epizooties (OIE). Manual of Standards for Diagnostic Tests and Vaccines. 4th ed. Paris: OIE (2000). p. 123–33.
54. Office International Des Epizooties (OIE). Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (mammals, birds and bees), 6th ed. Office International Des Epizooties, Paris. 2008: 712-724.
55. Perry BD, Randolph TF, Ashley S, Chimedza R, Forman T, Morrison J, Poulton C, Sibanda L, Stevens C, Tebele N, Yngstrom I . The impact and poverty reduction implications of foot and mouth disease control in South Africa with special reference to Zimbabwe", International Livestock Research Institute, Nairobi, Kenya, 152 pp. and CDROM, 2003.
56. Radostits DM, Blood DC, Gay CC. Veterinary Medicine. A Textbook of diseases of cattle, sheep, pigs, goats and horses. 8th ed. London. Bailliere Tindal.(2008) :748-785.
57. Radostits OM, Blood DC, Gay CC. Veterinary Medicine: A textbook of the diseases of cattle, sheep, pigs, goats and horses. 8th ed. Baillière Tindall. (1994): 910-913.
58. Radiostits OM, Gay CC, Hinchcliff , KW, Constable PD. Veterinary medicine: A textbook of the diseases of cattle, sheep, pigs, goats and horses, 10th edn., Saunders Elsevier, Philadelphia, PA,2006.
59. Regassa F.'Herd prevalence of contagious bovine pleuropneumonia (CBPP), bovine tuberculosis and dictyocaulosis in BodjiWoreda, West Wellega', Thesis for degree of Doctor Veterinary Medicine, Faculty of Veterinary Medicine, AddisAbaba University, DebreZeit, 2001.
60. Roger F, Yigezu L. The Situation of CBPP in Ethiopia. CIRAD-EMVT and National Veterinary Institute, Ethiopia, 1995.
61. Rushton J. The economics of animal health and production. CAB International, Oxford, 2009.
62. Sacchini F, Luciani M, Salini R,Scacchia M, Pini A,Lelli R, Naessens J, Poole J, Jores J.. Plasma levels of TNF- TNF- IFN- , IL-4 and IL-10 during a course of experimental contagious bovine pleuropneumonia, BMC Veterinary Research, 8(2012): 44.
63. Schnier C, Mtui-Malamsha, NJ, Cleaveland S, Kiara H, Grace D, McKeever DJ, et al., 2006, 'CBPP seroprevalence and associated risk factors in the Maasaiecosystem of south-western Kenya', Proceedings of the 11th International Symposium on Veterinary Epidemiology and Economics, August 6–11, 2006, Cairns, Australia.
64. Sery A, Sidib CAK´, Ciss O,´ e et al., "Seroprevalence of ´ contagious bovine pleuropneumonia (CBPP) in Mali," Tropical Animal Health and Production, vol. 47, no. 2, pp. 395–402, 2014.

65. Soromou LW, Dabo D, Cissé M, Sidimé Y, Keyra M, Sylla MK, Baldé A, Haba PF, Kéita F.Seroprevalence of contagious bovine pleuropneumonia in the prefecture of Dabola, Upper Guinea. Africa Journal of Animal and Biomedical Sciences 8(1).2014.
66. Swai E, Mwezimpya I, Ulicky E, Mbise A, Moshy W. 'An abattoir survey of contagious bovine pleuropneumonia lesions in slaughtered cattle in selected districts in Northern Tanzania', Asian Pacific Journal of Tropical Biomedicine 3(4), 303–306. 2013.
67. Tambi NE, Maina WO, Ndi C. An estimation of the economic impact of contagious bovine pleuropneumonia in Africa. Rev. sci. tech. Off. int. Epiz., 25 (3), pp.999-1012, 2006.
68. Taylor TK, Bashiruddin JB, Gould A. Application of diagnostic DNA probe for the differentiation of two types of Mycoplasma mycoides subspecies mycoides. Res. Vet. Sci. 53, 154-159. 1992.
69. Tegegne A, Mengistie T, Desalew T, Teka W, Dejen E. Transhumance cattle production system in North Gondar, Amhara Region, Ethiopia: Is it sustainable? Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project, (International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia). 2009.
70. Terlaak, E.A., 1992. Contagious bovine pleuropneumonia. A review. Vet. Quart. 15, 104-110.
71. Tesfaye M. Sero-prevalence of CBPP and its potential risk factors in selected sites of westen Oromia, Ethiopia. Ethiopia veterinary Journal. 2016; 20: 31- 41.
72. Teshale T, Temesgen T, Tsigabu N, Birhanu H, Solomon W, Tesfay A. Epidemiological status of contagious bovine pleuroPneumonia in southern zone of Tigray regions, northern Ethiopia, vol. 3, Animal and veterinary sciences. 2015.
73. Thomson GR. Contagious bovine pleuropneumonia and poverty: A strategy for addressing the effects of the disease in sub-Saharan Africa. Research Report, DFID Animal Health Programme, Centre for Tropical Veterinary Medicine, University of Edinburgh, UK, 2005.
74. Thornton PK. Livestock production: recent trends, future prospects. Philos Trans R Soc B Biol Sci 365:2853–2867, 2010.
75. Thrusfield M. Veterinary Epidemiology. 3rd ed. *Blackwell Science Ltd*. London. 2007.
76. Tolesa E, Eyob H, Fasil A. Study on Seroprevalence and risk factors of contagious bovine pleuropneumonia in Southern Nation and Nationality People of Ethiopia Regional State in Amaro Special District. Sci. Technol. Arts Res. J. 2015; 4: 106-112
77. Tuli G. Contagious pleuropneumonia. In Status of major animal diseases in Ethiopia (G. Abie, T. Eguale, E. Yimer and H. Lemecha, eds). Ministry of Agriculture, Ethiopia, 28–42. 2010.
78. Wanyoike SW. Assessment and Mapping of Contagious Bovine Pleuropneumoniain Kenya: Past and Present (MSc dissertation). FreieUniversität Berlin, Berlin. 1999.
79. Yigezu LM, Roger F. CBPP European Union Project component 2: Improvement of diagnostic methods competitive ELISA Kit assessment Report of the second semester year 2 National Veterinary Institute, Ethiopia. 1997.

6. Appendix

LIST OF ABBREVIATIONS

CBPP	Contagious Bovine Pleuropneumonia
c-ELISA	Competitive Enzyme Linked Immunosorbent Assay
CIRAD-EMVT	Centre de cooperation Internationale en recherche agronomique pour le développement- Département élevage et médecine vétérinaire
CSA	Central Statistical Agency
FAO	Food and Agricultural Organization
FMD	Foot and Mouth Disease
MmmSc	Mycoplasma mycoides subspecies mycoides Small Colony type
NGOs	Nongovernmental Organizations
NVI	National Veterinary Institute
OIE	Office of International Des Epizootics
PCR	Polymerase Chain reaction
PFE	Pastoralist Forum Ethiopia
SNNP	Sothern Nations and Nationalities People
SPSS	Statistical Package for Social Science

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KINETIC STUDY OF ADSORPTION OF METHYL RED DYE ON PERICARP CHARCOAL OF ADANSONIA DIGITATA(BAOBAB)

David Mihayo L* and Mastan Rao K

ABSTRACT

Activated charcoal prepared from Adansonia Digitata(baobab) pericarp has been used for the removal of methyl red dye from simulated aqueous solutions employing adsorption method. The effect of adsorption was studied by using different parameters such as pH(2-4), contact time(50-200min), initial dye concentration(50-200mg/L) and adsorbent dosage(1-4g). The extent of adsorption was determined by employing uv-vis spectrometer. The experimental data was verified by Freundlich model and found to be satisfactory. Under the experimental conditions the parameters at the maximum adsorption ability have been determined for the dye and reported.

Keywords: Biosorption, methyl red dye, baobab pericarp charcoal

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1. INTRODUCTION

Dyes are synthetic aromatic compounds that are stable and difficult to be degraded (yenikaya, et al., 2010). Most of the dyes are complex organic molecules. According to the chemical structure, dyes can be divided into Azo dyes, Aryl dyes, Acridine dyes etc. Azo dyes are the mostly used in industrial activities. Dyes are used in production of the essential consumer products of modern life such as textile, leather, cosmetic, foods and beverages, papers and pulp which cause the environmental pollution problems and threat to the ecological balance (Ulas, et al., 2017).

Synthetic dyes are extensively used for coloring and printing in variety of industry (mohanraj, 2009). The dye based effluent is a considerable source of non-aesthetic pollution since the presence of small amount of dye (below 1 ppm) is clearly visible. Many researchers found that colorant may cause problems in aquatic ecosystem in several ways (yenikaya, et al., 2010). Worldwide, infectious diseases such as water-borne diseases are the number one killer of children under five years old and more people die from unsafe water annually than from all forms of violence, including war (Edogbanya, et al., 2013a). The problem of water pollution has become an issue drawing global attention. Every day, two million tons of sewage, industrial and agricultural waste are discharged into the world's waste water bodies (WWAD, 2006). There are several ways for removal of dyes; adsorption has been considered for the removal of textile dyes effluents due to its low cost, easy availability, simplicity of design, high efficiency, ease of operations and ability to treat wide variety of dyes (Ramalkashmi, et al., 2012). Activated carbon is a carbonaceous adsorbent with a highly crystalline form and internal pore structure (Kavitha 2019). A wide variety of activated carbon products are available depending upon a starting raw material and activation techniques (Gupta, 2003). It is used to recover organic solvent, purify carbon dioxide from fermentation process, purification of drinking water, amine, and glycol treating, decolorizing of water and various other chemical and petrochemical process (Sircar, et al., 1996). The mount of dyes absorbed per unit mass of absorption increase with increase with concentration (Omprakash, et al., 2019). At lower pH of solution, the percentage of dye removal decreases for cationic dye adsorption while for anionic dyes the percentage of dye removal increases and vice versa (singh, 2019).

The Baobab tree mostly found in the equatorial area such as Gabon, Democratic Congo Zaire and the area with marked dry season (Gebauer, et al., 2002) such as Dodoma region in Tanzania. It is a tree of multiple uses and it is said that all parts of the tree are useful. Generally baobab fruits and seed oil are used for human consumption and the rest of the tree parts are used as traditional medicine (simon, 2015). The baobab tree is known to human beings for 200 years. Baobab trees are grown in thirty two African countries, they live for up to 5000 years and reach upto 30 meters high (Anna, et al., 2019). Baobab belongs to genus:Adansonia and Species- Adansonia digitata. In the present study, methyl red is used as a simulated adsorbate and baobab fruit pericarp charcoal as adsorbent.

2. MATERIALS AND METHODS

2.1 Preparation of dye solution

Stock solution of dye concentration 1000 mg/L was prepared by dissolving 1g of 100% pure methyl red in 1000mL of distilled water by using standard flasks. Solutions of different concentrations were prepared by dilution method between 20 and 200 mg/L using the stock solution of the dye. All chemicals of 99.9% purity have been used in the present study.

2.2. Preparation of Pericarp biosorbent

Fruits of adansonia digitata were collected from a single tree in Dodoma region at Kongwa district. The dried fruits were broken and the seeds were removed. The pericarp pieces were properly washed with distilled water, dried under the sun, pulverized into powder using grinding machine, sieved through a pore size of about 1mm. The dried pericarp sample was treated with sulfuric acid with constant stirring. Then the sample was kept in hot air oven at 200±50k temperature for twelve hours. The sample was washed with distilled water and soaked in sodium bicarbonate solution and then allowed to stand overnight to remove the residual acid from the pores of carbon. The sample was washed again with distilled water, until the pH of the adsorbent becomes neutral (7±0.2). Then the sample was dried in a hot air over at 100±5℃ for twelve hours. The dried sample was ground to get a powder of particle size about 125-250µm range and stored in an airtight container for further experiments.

2.3 Batch mode biosorption studies

A standard calibration plot between the adsorbate concentration and absorbance was drawn. Batch biosorption equilibrium experiments were conducted in 250 mL conical flasks at a constant agitation speed (180 rpm). All the experiments were carried out at room temperature (30^0C). The concentrations of the dyes both before and after adsorption were determined using Agilent 60 carry UV- Vis spectrophotometer, USA through monitoring the absorbance for the dye used. Initial concentration of the dye, adsorbent dosage, pH of solution, temperature and contact time between adsorbent and adsorbate are the most important factors that affect adsorption process. The effect of initial dye concentration was studied in the concentration range 50-200 mg/L at optimized conditions. The pH was studied in the intervals of 2, 4, 6 and 8. The effect of mass of adsorbent was studied in the range 1gram to 4gram at constant dye concentration 200mg/L and optimized conditions. The effect of contact time was studied in the constant dye concentration of 200 mg/L and time range from 50 minutes to 200 minutes

3. RESULTS AND DISCUSSION

3.1 Effect of initial concentration of dye

The effect of initial dye concentration was studied in the concentration range 50-200 mg/L at optimized conditions. The extent of adsorption of dye per gram of activated

carbon was calculated and reported in Table No:1. A plot is drawn between adsorbate concentration and adsorption ability and shown in Fig.1.
x/w = extent of adsorption (mg/g), V = Volume of dye solution (L), Ci = initial concentrations (mg/L), Cf = final concentrations of dye (mg/L) , w = dry weight of the activated carbon (g)

Table 1: Data showing initial concentration of dye solution and adsorption ability

S/N	Ci (ppm)	w (g)	Absorbance	Cf (ppm)	Ci-Cf (ppm)	x(mg)	x/w (mg/g)
1	50	1.02	0.1077	23	27	0.317	0.311
2	100	1.05	0.1139	33	67	0.766	0.729
3	150	1.00	0.1215	46	104	1.25	1.25
4	200	1.14	0.1305	61	139	1.46	1.281

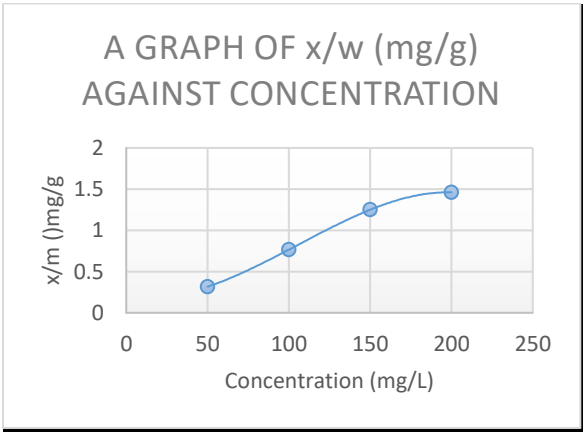


Fig:1 Adsorbate concentration vs. Adsorption ability

It is observed from the graph that as the initial concentration of adsorbate increases, adsorption ability increase to a certain extent and thereby remains constant. This may be due to the saturation of the active sites due to adsorption on the surface of adsorbent.

3.2 Adsorption isotherm

Adsorption isotherm has been studied on the extent of adsorption of adsorbate on the adsorbent by using Freundlich adsorption model. According to the Freundlich isotherm model, the amount of adsorption at low concentration varies linearly, at moderate concentration become dependent on the Freundlich constant and at higher concentration becomes independent of the adsorbate concentration. From the Fig:1 above, it shows that the experiment obeys the Freundlich model satisfactorily. Further

it is verified by plotting a logarithmic graph (Fig:2) and found to be a straight line which is expected of the above results.
x/w – extent of adsorption, C – equilibrium concentration of solute in aqueous medium K and n are Freundlich constants which depend upon the nature of adsorbent and adsorbate.

Table 2: Effect of concentration of adsorbate on adsorption

S/N	x/w (mg/g)	Ci (mg/L)	Log x/m	Log Ci
1	0.311	50	-0.51	1.7
2	0.729	100	-0.14	2
3	1.25	150	0.0969	2.17
4	1.281	200	0.11	2.3

From the Freundlich adsorption isotherm, the value of n and K are found to be 1 and $4.445x10^{-3}$ mg/L respectively.

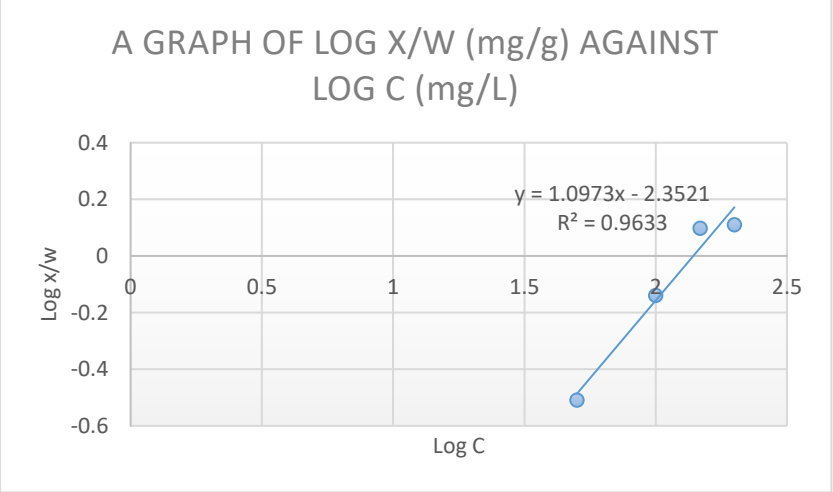


Fig 2: Freundlich adsorption isotherm

3.3 Effect of adsorbent dosage

The effect of mass of absorbent was studied in the range of 1gram to 4gram at constant adsorbate concentration of 200mg/L and optimized conditions. The extent of

adsorption of dye per gram of activated carbon was calculated and reported in Table No: 3. A plot is drawn between adsorbent dosage and adsorption percentage is shown in the Fig.3.

Table 3: Adsorbent dosage vs. absorbance data

S/N	Ci (ppm)	W (g)	Absorbance	Cf (ppm)	Ci-Cf (ppm)	X (mg)	x/w (mg/g)	q %
1	200	1.10	0.1220	46.83	153.17	3.68	3.35	76.6
2	200	2.01	0.1177	38.67	161.33	3.87	1.93	80.66
3	200	3.03	0.1101	27	173	4.15	1.37	86.5
4	200	4.14	0.1091	25.3	174.7	4.19	1.01	87.3

It was observed that the extent of adsorption increases with an increase in the mass of adsorbent (activated carbon) from 1-4 gram which may be due to the availability of unsaturated surface area (active sites).

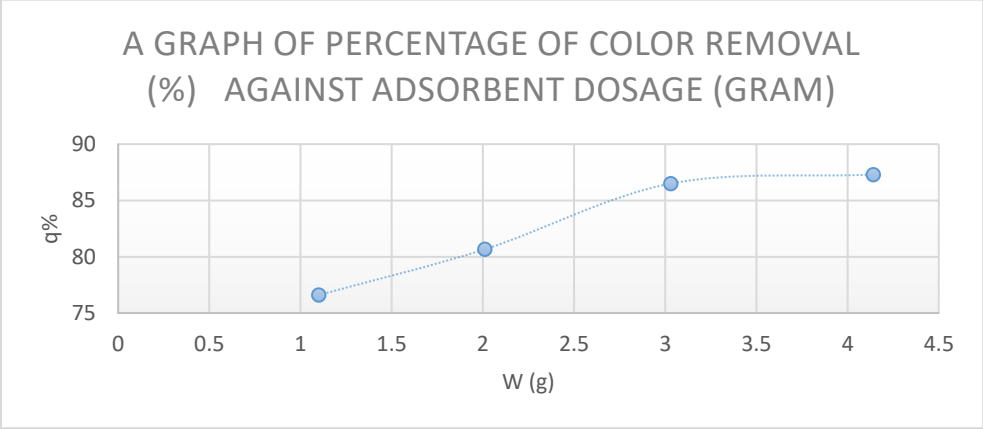


Fig 3: Graph between adsorbent dosage and adsorption percentage

3.4 Effect of pH

The effect of pH was studied at a constant concentration of 200 mg/L of adsorbent and pH range 2-8. The extent of adsorption of dye per gram of activated carbon was calculated and reported in table No.4
x/w = extent of adsorption (mg/g)
V = Volume of dye solution (L), Ci = initial concentrations (mg/L), Cf = final concentrations of dye (mg/L) , W = dry weight of the activated carbon (g)

The percentage of adsorption of the dye was calculated as, $q\% = \frac{(Ci-Cf)}{Ci}$.

Table 4: Data showing the variation of absorbance with change in pH at a constant mass of adsorbent

S/N	W (g)	pH	Absorbance	Cf (ppm)	Ci-Cf (ppm)	X (mg)	x/w (mg/g)	q%
1	4.12	2.46	0.0952	2.16	197.84	4.75	1.15	98.9
2	4.25	4.37	0.0969	5.00	195	4.68	1.10	97.5
3	4.16	6.57	0.0982	7.17	192.83	4.63	1.11	96.4
4	4.03	8.42	0.1000	10.2	189.80	4.55	1.13	94.8

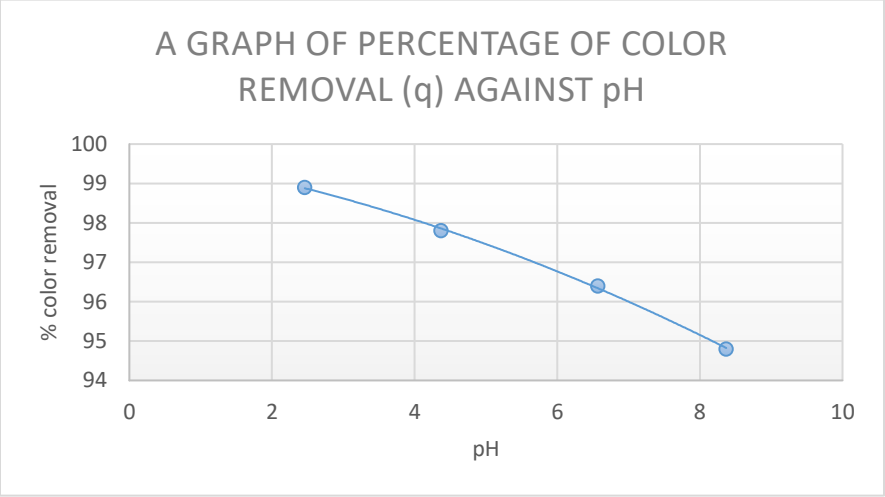


Fig 4: Effect of pH on the adsorbate concentration

The adsorbate shows a maximum adsorption at pH 2.46 with maximum percentage of adsorption of 98.9%, because it works efficiently on the acidic medium than in a basic medium. Methyl red is an anionic azo dye, hence at lower pH it shows higher adsorption due to the positively charged surface of the adsorbent.

3.5 Effect of contact time

The effect of contact time was studied at a constant concentration of 200 mg/L and time range from 50 minutes to 200 minutes. The extent of adsorption of dye per gram of activated carbon was calculated and reported in Table no:5 below.

The percentage of color removal in the dye solution after adsorption was calculated as $q\% = \frac{(Ci-Cf)}{Ci}$.

Table 5: Data showing the effect of contact time on adsorption ability

S/N	W (g)	Contact time (minute)	Absorbance	Cf (ppm)	Ci-Cf (ppm)	X (mg)	x/m (mg/g)	q%
1	4.09	50	0.1216	46.17	153.83	3.69	0,90	76.92
2	4.11	100	0.1207	34.7	155.3	3.73	0.91	77.65
3	4.02	150	0.1101	17	173	4.15	1.03	86.5
4	4.18	200	0.0960	3.5	196.5	4.72	1.13	98.25

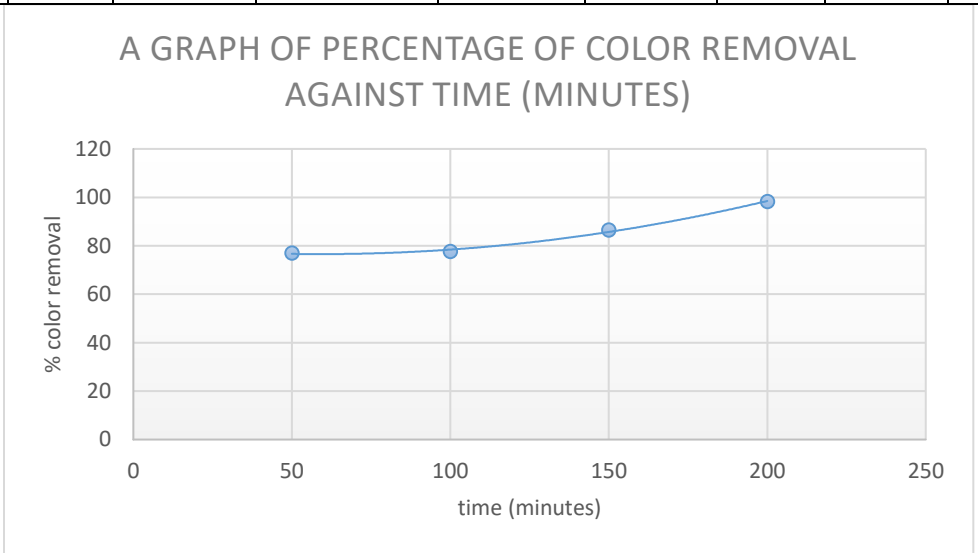


Fig 5: Effect of contact time on the adsorption ability

The removal of methyl red by activated carbon as a function of time was observed. Initially, the adsorption of dye is measurable during the time interval of 50 to 150 min and later, the adsorption process becomes less significant and remains nearly constant. The adsorption efficiency was found to be 98.25%.

4. CONCLUSION

The data obtained from the adsorption studies showed that a contact time of 200 min was sufficient for the maximum removal of methyl red dye from aqueous solution using baobab pericarp charcoal. The experimental data of biosorption of the dye on the baobab charcoal biosorbent fits well with the Freundlich adsorption model. This indicates that the biosorption of the dye on the baobab charcoal is favourable. The

maximum removal efficiency was predicted to be 98.25% at a temperature of 303K, solution pH of 2.45, and initial dye concentration of 200 mg/L and biosorbent dosage of 4.0g. Further investigation of the adsorption characteristics like surface area of the adsorbent and adsorption thickness are suggested to understand the adsorption mechanism.

5. REFERENCES

1. **Anna chladova and kathleen prinz** (2019) Genetic diversity and structure of baobab (adansonia digitata L.) in southeastern kenya, Royal Society Open Science, 6 (9) 190854
2. **Edogbanya P.R.O, Ocholi O.J and y Apeji** (2013a), A review on the use of plant seed as biocoagulants in purification of water, Continental J.of Biological Sciences 6(2) pp26-32 .
   http://www.wiloludjournal.com
3. **Gebauer J, El-sidding K and Elbert (2002), G** Baobab (adansonia digitata): a review on multipurpose tree, Gartenbauwissenschaft, 7(4) 155-160
4. **Gupta, V. K., I. Ali, and Dinesh Mohan (2003)**, Equilibrium uptake and sorption dynamics for the removal of a basic dye (basic red) using low-cost adsorbents, Journal of colloid and interface science, 265 (2) 257-264.
5. **Kavitha, D and C. Namasivayam (2007**). "Experimental and kinetic studies on methylene blue adsorption by coir pith carbon."Bioresource Technology, 98 (1) (2007) 14-21.
6. **Mohanraj Rangaswamy** (2009)Adsorption of crystal violet dye from aqueous solution using Eicinus Communis pericarp carbon as an adsorbent, E-Journal of Chemistry, 6(4) 1109-1116.
7. **Omprakash Sahu and Nagender Singh(1918),** Significance of biosorption process on textile industry waste water Book, Impact and Prospects of Green Chemistry for Textile technology(pp 367-416).
8. **Ramalkashmi S and Muthucheliam K** (2012) Comparatives studies on removal of fast green dyes from aqeous solution by activated carbon prepared from Gloriosa superba waste and alternaria raphani fungal biomass, Journal of Environmental Science and Technology (5) 222-231
   https://scialert.net/abstract/?doi=jest.2012.222.231
9. **Singh Nagender(2019)** Imparct and prospect of green chemistry for textile technology Book Review.
10. **Sircar S and Rao B.M** (1996), Activated carbon for gas separation and storage, Carbon, 34(1) pp1-12
11. **Simon J** (2015) Bobab: the tree of life- An Enthnopharmacological review, The Journal of the American Botanical council, (108) pp42-53
12. **Ulas calisir and kiline Namlik(2017,** Biosorption for dyes removal from industrial waste water Int.J.Adv.Res.5(8),707-714.
    http://dx.doi.org/10.21474/IJAR01/5110
13. **Yenikaya Cengiz. and Atar Emrah(** 2010), Biosorption study of anionic dye from aqoues solution using bacillus amyloliquefaciens, Wiley online library, (10) pp233-241 https://doi.org/10.1002/elsc.200900108