ISSN ONLINE : 2707 5052
ISSN PRINT : 2707 5060

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Daagu International Journal of Basic and Applied Research (DIJBAR)

Volume-1
2019



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Volume 1 Issue 1

Bioconcentration of Heavy Metals in Cabbage and Tomato Growing near Copper Polluting Facilities on the Copperbelt Province, Zambia
Jean Moussa Kourouma, Stephen Syampungani, Concillia Monde 9-25

Feed Resource Availability, Livestock Migration Pattern and Synthesis of Feeding Calendar at WagLasta, Ethiopia
Bekahgn Wondim, Mulatu Gobeze, Baye Biresaw 26-40

Reading and Writing the World with Statistics: Critical Understanding for Social Justice
Mulugeta Woldemicheal Gebresenbet 41-57

A Critical Appraisal of Amaranths and

Chenopodium Weeds for Their Harmful and Beneficial Aspects in Context to Food Security in

Pastoral Area
Mohammed Gufran Khan, M. Abate, Endris S. Abebe Chaka 58-69

The Role of Information and Communication Technology for Gender Equality: The Case of

Assosa Zone, Ethiopia
Shambel Ferede Assemahagn and Hambisa Mitiku Gebre 70-79

Quality of Education with the Focus of Faculty Competencies, Research Leads Student Cognitive and Collaborative Learning Techniques in the Class Room
Mekapotula Srinivasa Chakravarthi 80-88

Volume 1 Issue 2

Growth, yield and nitrogen use efficiency of green bean (*Phaseolus vulgaris* L.) As influenced by rate of biochar and nitrogen fertilizer at Jimma, southwestern Ethiopia
Osman Ahmed, Amsalu Nebiyu and Milkiyas Ahmed 1-11

Study on the prevalence of ovine gastrointestinal tract nematodes in and around Hawassa town, southern Ethiopia
Sileshi Shilote, Faizullah Peer, and Gizachew Fentahun 12-23

Critical Analysis on Frequency of Amharic Sounds: the perspective of corpus Linguistics
Samuel Leykun 24-37

Software piracy understanding, challenges, detection and prevention in higher education students of Ethiopia
Abdulahi Mahammed Adem 38-46

Biosorption of Congo red from aqueous solutions using C*leodendrum fragrans leaves*: kinetic and thermodynamic studies
Ravi Kumar Madugula, King Pulipati, AytenewGetaye, EliasBarsenga and DejenMandefro 47-60

Class room management during a group discussion in English; the case of Mada Walabu university first year English language and literature students
Samuel Leykun and Negash Demise 61-79

DIJBAR
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Volume-1 Issue-1

Bio concentration of Heavy Metals in Cabbage and Tomato Growing near Copper Polluting Facilities on the Copperbelt Province, Zambia

Jean Moussa Kourouma [1], Stephen Syampungani [1], Concillia Monde [2]

ABSTRACT

The current study was undertaken to evaluate the degree of pollution and bioaccumulation of heavy metals; Cu, Cd, Zn, Ni and Pb from the soils of the Copperbelt Province to the edible parts of cabbage (*Brassica oleracea var. Capita l.)* and tomato (*Lycopersicum esculentum Mill)* using the Bioaccumulation Factor (BAF), Contamination Load Index (CLI) and Nemerow Integrated Pollution Index (NIPI). Cu, Cd, Ni, Pb and Zn in soils, cabbage and tomato leaves and fruits from industrial and non-industrial areas in Kitwe, Mufulira and Chingola districts of Copperbelt Province, Zambia were determined after acid digestion by using atomic absorption spectrophotometry (AAS). Very high metal transference from soil to cabbage and tomatoes observed, it is a concern for public health particularly for urban population which consumes the roots, stems, stalks, leaves or fruits of these vegetables. The result showed that BAF in both species were below 1 except for cabbage which accumulate Cd to the critical limit of BAF=1 in areas close to the mine polluting facility. The CLI was above 1 for the studied metals in soil samples collected near the mine polluting facility while in the control site, only Cd, Ni in cabbage and Cd, Pb in tomato were found above the threshold value of 1. The NIPI indicated an extreme soil contamination by all the studied elements in samples collected around the mining generated wastelands. In the control sites only, Cu and Cd exceeded NIPI ≥ 3, indicating that even in the control sites, soils and crops are seriously contaminated by Cu and Cd, slightly contaminated by Zn and Pb and at alert level for Ni. This high level of contamination shows that sufficient attention should be given to the soils of the Copperbelt and to the crops grown in those areas. Consuming such crops may pose increased health risks to the local population.

Citation:

Jean Moussa Kourouma, Stephen Syampungani, Concillia Monde (2019). Bio concentration of Heavy Metals in Cabbage and Tomato Growing near Copper Polluting Facilities on the Copperbelt Province, Zambia. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-1, pp (9-25)

Corresponding Author: Jean Moussa Kourouma

Email: kjeanmoussa@gmail.com

Received: 02/02/2019

Accepted: 15/03/2019

Published: 10/06/2019

OPEN ACCESS

Keywords: Contamination, Heavy metals, Bioaccumulation, Pollution

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1. INTRODUCTION

Contamination of soils with heavy metals is one of the current environmental problems in the world (Gratão *et al.,* 2015). The contamination may occur due to either, industrial or natural activities that result in the deposition of heavy metals in the environment (Khan *et al.,* 2008; Zang *et al.,* 2010; Liu *et al.,* 2016). This has an effect on the food chain in that it terms to contaminate some organisms that are consumed by other organisms in the lower trophic levels.

A number of studies on leafy vegetables and fruits grown in locations close to industries and roadsides have reported elevated levels of heavy metals in their edible parts (Grant and Dobbs, 1977; Xiong, 1998;Kachenko and Singh, 2006; Yang *et al.*, 2007; Lăcătuşu, 2008; Siame *et al.,* 2016), observed that tissues of cabbage *(Brassica oleracea)*and tomato *(Lycopersicum esculentum)* accumulate significantly heavy metals such as Zn in its edible parts. According to Sawidis, (2001), the uptake and accumulation of heavy metals by plants follows two different paths, which are the root system and the foliar surface.

Evidence of soil pollution arising from presence of heavy metals associated with mining activities in the mining agro-ecosystems of Zambia's Copperbelt Province has been documented researchers working on those agro-ecosystems, among others Kříbek *et al*., (2010) and Kapungwe*et al*., (2013). However, even with documented evidence of contamination of soils on the Copperbelt province, studies on the degree of vegetables contamination by heavy metals have not yet been conducted although cultivation goes in the vicinity of the polluting facilities such as tailings dams and smelter plants. Therefore, the aim of this study was to investigate the degree of contamination and bioaccumulation of heavy metals in vegetables grown within the polluted environment of the Copperbelt province of Zambia. Additionally, the study was designed to determine the extent of pollution in sites within vicinity of potential polluting facilities.

The objectives of the study were (i) to correlate the concentrations of metals (Cu, Cd, Zn, Ni, and Pb) in soils and vegetables grown in heavy metal polluted environment and the control sites;(ii) to compare the potential pollution indices of soil of the mining areas and the control sites using Pollution index (Pi), and Nemerow Integrated Pollution index (NIPI); and (iii) to compare the Bioaccumulation factor (BAF) and Contamination Load index (CLI) between cabbage and tomato cultivated in the mining areas and those of the control sites.

2. MATERIAL AND METHODS

2.1 Description of the study area

The study was undertaken within the selected sites in Kitwe, Mufulira and Chingola districts of the Copperbelt Province (Figure 1). The sites that are close and exposed to some mines potential polluting facilities and where farmlands are allotted for growing

cabbage and tomato throughout the year were purposively selected for inclusion in the study.

The control sites were selected at approximately 25 km away any mine polluting facility. The climate of the Copperbelt Province is characterized by three distinct seasons; the warm dry season (August to October), the warm wet season (November to April) and the cold dry season (May to August) (KCC, 2010). The Province receives up to 1600 mm of rainfall annually with temperatures ranging from 18° to 28° C (Sracek, 2015).

The soils are mainly ferrasols (acric, orthic or rhodic ferrasols) (FAO-UNESCO, 1997) with the principal soil forming process in the area being rock weathering; hence, climatic factors influence the rate and depth of weathering and the soil formation.

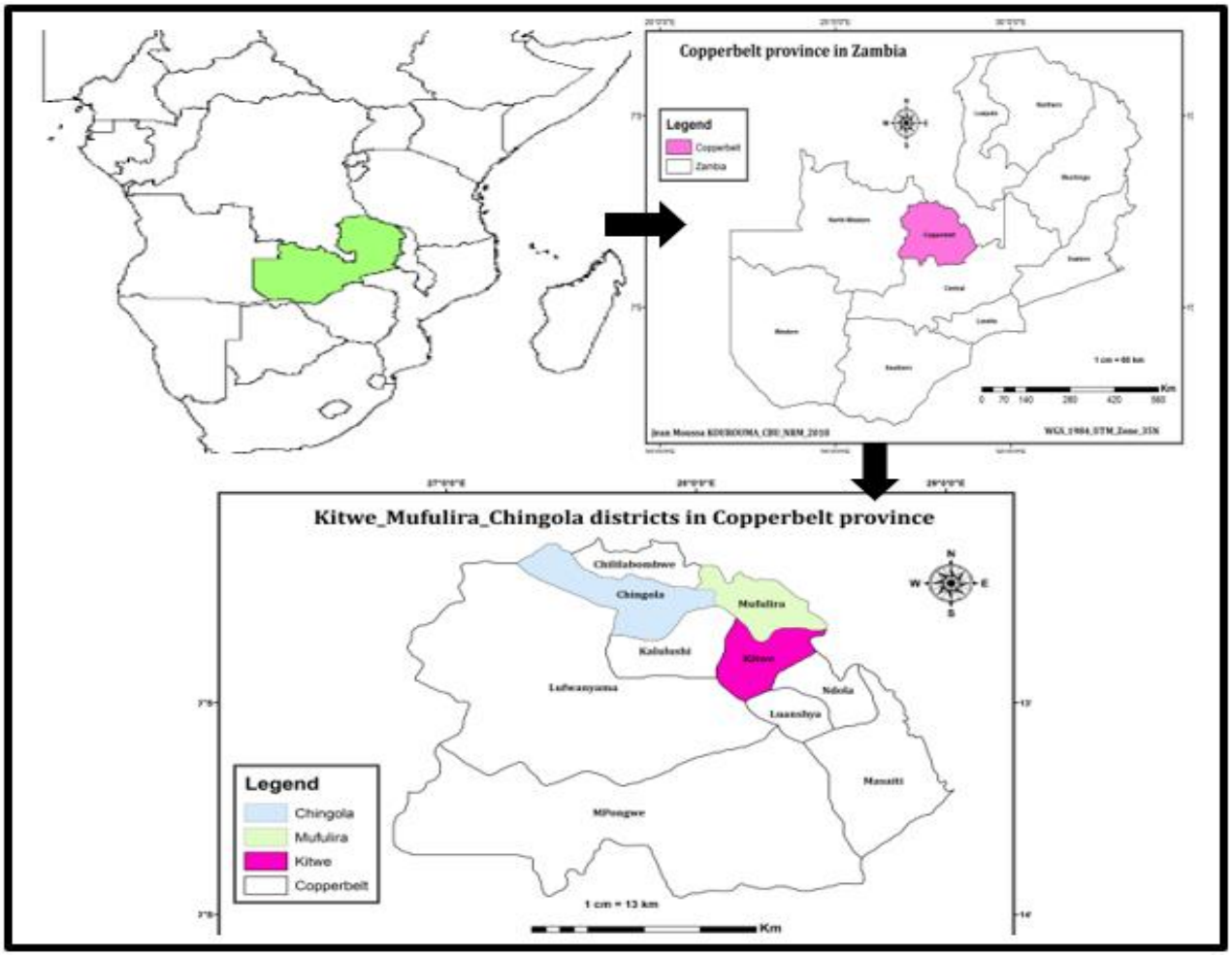


Fig. 1 Location Map of the Study Area in Copperbelt

2.2 Samples collection

The sampling sites were located within 0.5 km downstream of tailings facilities in each of the selected district. Additionally, a control site on each study site was chosen at 25 km away from theany mine polluting facility but in the area of the same geological formation as the other sampling sites. The sample plots of 400 m^2 were systematically established along 25 km transect. Each main plot was divided into 5 sub-plots of 9 m^2 from which the sample collection was undertaken. Five soil samples were collected at 0-20 cm depth from each corner and the center of each sub-plot and then mixed together in a bucket to get a composite sample. Fifteen (15) samples each of cabbage and tomato were randomly collected per sample plot. Table 1 shows the total number of samples with respective weights collected on each site.

Table 1. Informative Table of the Sampling Design and Techniques

Sampling points	**Treatment 1** (Polluting facility)	**Treatment 2** (Control site)
	0.5 km	25 km
Total number of sub-plots / Field block	15	15
Total weight of Soil composite samples/Field block	15 kg	15 kg
Total of Tomato samples collected /Field block	15	15
Total of Cabbage samples collected /Field block	15	15

2.3 Preparation of soils and vegetables for analysis

Samples were air-dried for several days before passing them through a 2 mm nylon sieve to remove sand and any other debris that may have been collected. These were then repacked in transparent plastic bags and 0.5 g of the powdered sample was digested. For convenience in the analysis, two different digestion procedures were employed to prepare samples for all metal analyses. Each soil sample was placed in the 250 cm^3 conical beakers and 30 ml of 0.5 M nitric acid was added. The mixture was stirred and heated at 200°C for 30 minutes on a hot-plate, then, 3 ml of Hydrofluoric acid (HF) was added and reheated to extract the total metal content in the soil samples. The digestion liquids were evaporated to near dryness to remove HF. The residuals were then diluted with triple distilled water and filtered through ashless Whatman filter paper No.40. The atomic Absorption Spectrophotometer (AAS) was used to measure the concentration of heavy metals in the final solutions. The heavy metals analyzed by the AAS included nickel, zinc, copper, lead and cadmium.Plant samples were washed with distilled water to eliminate air-borne pollutants and those that may have been on the surface of the plants. The samples were sliced and then air dried. Thereafter, the samples were oven-dried at 80°C for 24 hours. Each oven-dried sample was ground using a mortar until and then sieved using a 0.18 mm sieve.

The ground samples were then weighed and 2g of each sample was also placed in a clean dry 250 cm^3 conical flasks and then 30 ml of 0.5 M nitric acid was added. The

mixture was heated at 200°C for 30 minutes using hot-plate after which 10 ml of Perchloric acid ($HCLO_4$) was added on the plant samples to extract total metal concentration. The samples were then diluted into 100 cm^3 of distilled water and filtered through ashless Whatman filter paper 40. The concentration of heavy metals in the final solutions was measured by Atomic Absorption Spectrophotometer (AAS).

2.4 Data analysis

All the data were checked for homogeneity of variance (Levene test) and normality tests of Shapiro wilk ($p<0.05$) was applied to investigate the normal distribution of the data at a confidence level of 95%. Independent t-test was conducted to detect if there is a significant difference between the means of soil, tomato and cabbage grown within the mining area (0.5 km from the mine) and the control site (25 km away from the mine). All the analyses were performed with R (Inc., Chicago. IL, USA) and SPSS. Then each specific aspect of the collected data was analyzed separately as shown in the subsections below.

2.4.1 Heavy metals accumulation assessment

The mean values for Zn, Ni, Cu, Cd and Pb concentration in the three (3) districts were used to represent the concentrations of the Copperbelt urban towns. The degree of accumulation of each metal was calculated based on Zhang *et al.*, (2015) Eq. (1) as follow:

$$A_m = C_m - B_m \qquad \text{Equ.1}$$

Where A_m is the metal accumulation in province m, C_m and B_m are the metals concentration and background value respectively in province m.

2.4.2 Nemerow integrated pollution index (NIPI)

A sub-index (NIPI) of each contaminant was calculated by comparing the measured value of each heavy metal in the soil sampling area with the evaluation standard. The integrated pollution index of Nemerow was determined in order to show the degree of contamination of soil quality and the likely impact on crops or plants growing on such soils. The Nemerow integrated pollution index was calculated using Equation 2 below:

$$NIPI = \sqrt{\left[\left(\frac{C_m sample}{B_n}\right)^2_{aver} + \left(\frac{C_m sample}{B_n}\right)^2_{max}\right]} \qquad \text{Equ.2}$$

Where NIPI is the Nemerow integrated pollution indexof the soil, $(C_m/B_n)_{aver}$ is the average value of the concentration factor and $(C_m/B_n)_{max}$ is the maximum value of the single pollution index. The soil pollution grade standard for Environmental Quality Assessment and Green Food Growing Areas compiled in 1994 was used in this study (see below table 2).

Table 2: Classification criteria for the Comprehensive Soil assessment

Grade division	NIPI	Contamination level	Contamination degree
1	NIPI ≤ 0.7	Safe	Clean
2	0.7 ≤ NIPI ≤ 1	Alert	Still clean
3	1 < NIPI ≤ 2	Light contamination	Soil slightly contaminated
4	2 < NIPI ≤ 3	Moderate contamination	Soil and crops moderately contaminated
5	NIPI > 3	Severe contamination	Soil and crops seriously contaminated

Pi was calculated to assess soil contamination level of heavy metals; a pollution index (Pi) of each metal was attributed to each metal using Equation 3 (Wei , *et al.*, 2015) below:

$$Pi = \frac{C_m Sample}{B_n} \qquad \text{Equ.3}$$

Where C_m (mg/kg) is the concentration of each heavy metal and B_n is background value for each metal (mg/kg). The higher the Pi the greater the soil contamination (Table 3).

Table 3: Contamination categories based on Pollution index (Pi)

Pollution index (Pi)	Contamination level
Pi < 1	refers to low contamination;
1 ≤ Pi <3	means moderate contamination;
3 ≤ Pi≤ 6	indicates considerable contamination
Pi > 6	indicates very high contamination

Background value consideration

The Background values have been considered as a basis for assessment of anthropogenic pollution in many parts of the world in environmental sciences, Reimann & Garrett, (2005) defined the background value, as the concentration of an element in a sample far away enough from an eventual contaminant source. For the purpose of this study, the world soil background values ofHooda, (2010) were used as the reference concentration for the studied elementsof Copperbelt soils,Cu =25 mg/kg, Cd= 0.3 mg/kg; Zn= 70 mg/kg; Pb= 29.2 mg/kg; Ni= 75 mg/kg. This is in line with the common practice adopted by many other researchers (see Martin and Meybeck, 1979; Rath *et al.*, 2005). Several authors around the world (Hooda, 2015; Wu *et al.*, 2015) have considered average concentrations of individual metals of world surface rocks as the background values.

2.4.3. Bioaccumulation and Contamination determination method

Bioaccumulation Factor (BAF) and Contamination Load Index (CLI) of Wilberforce, (2015) were used to assess the degree of contamination in tomato and cabbage for the selected study sites.

2.4.4Bio-accumulation factor (BAF)

The BAF is used to estimate potential human health risks posed by heavy metals occurring in edible parts of the plant. It is calculated using equation (4) as follows:

$$BAF = \frac{Cplant\left(\mu g g^{-1}(edible\ parts)\right)}{Csoil\ (\mu g g^{-1})\ Concentration} \qquad \text{Equ.4}$$

Where C_{plant} and C_{soil} represent heavy metal concentration in edible parts of vegetables and soil, respectively.BAF of 0.1 indicates that plant is excluding the element from its tissues while the BAF of 0.2 for vegetables indicate the chances of metal contamination by anthropogenic activities and high metal uptake from soil by the edible plant(Khan, *et al.,* 2009)and so the need for environmental monitoring of the area will be required (Sponza & Karaoglu, 2002).

2.4.5 Contamination Load Index (CLI)

Contamination Load Index (CLI) also known as the Pollution Index (PI) is the ratio of metal concentration in a biotic or abiotic medium to that of the regulatory Standard of International bodies such as Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the United States Environmental Protection Agency (USEPA) (Arain *et al.,* 2009). The following equation (5) was used determine CLI level in crops (edible parts of crops).

$$CLI = \frac{C_{crop}}{MPC} \qquad \text{Equ.5}$$

Where C_{crop} is the heavy metal concentrations in the edible portion of plants and MPC is the maximum permitted concentration of heavy metal in crops (FAO, 1984).

3. RESULTS

3.1 Comparison of Heavy metals content in soils and vegetables between mining areas and control sites

The analysis also revealed significant difference in metal concentration between soil collected at 0.5 km from the polluting facilities and those collected from the control sites (Table 4).Copper has the highest concentration (1172±298.98 mg/kg) followed by Zinc (195.2±15.84 mg/kg). There is a significant difference in metal concentration between soils collected at 0.5 km from the mining areas and those collected from the control sites located at (25 km) from the mines (Table 4).

Table 4. Heavy metal concentration (mg/Kg) in soil

Sampling sites	Statistical indices	Cu	Cd	Zn	Ni	Pb
Mining/smelting areas N=15	Mean±Se	1172.80±298.98	7.73±1.37	195.2±15.84	171.33±10.7	153.7±14.70
	Skewness	-0.145	0.726	-0.045	-0.339	-1.584
	Kurtosis	-0.291	-1.131	-0.629	-0.367	3.781
	CV (%)	83.4	92.75	59.5	50.8	54.8

Control sites N=15	Mean±Se	109.47±7.36	2.00±0.00	38.93±3.48	31.53±4.232	28.80±2.95
	Skewness	0.669	0.726	0.593	-2.189	-0.975
	Kurtosis	-0.807	-1.131	-0.932	5.941	1.162
	CV (%)	105.7	64.5	86.8	45.6	50.3
Shapiro wilk test	p-value	0.235[a]	0.0001**	0.241[a]	0.136[a]	0.0001**
Independent t-test	p-value	0.0001**	0.001*	0.001*	0.007*	0.008*
FAO/WHO (1984) Safe limit		100	3	300	60	300

'Two. Sided'. Conf. level=.95. * = significant at $p < 0.05$; ** = significant at $p < 0.01$; a= non-significant

Cabbage: In terms of heavy metal concentration in vegetables, Cu (51.4±7.63 mg/kg) had the highest concentration followed by Zn (72.2±7.95 mg/kg) in cabbage growing near mining areas compared to the control site (Table 5). Independent t-test showed significant difference between the means of all metals except for Ni and Ni ($p>0.05$) in cabbage collected from the mining areas and the control sites (Table 5).

Table 5. Heavy metals concentration (mg/Kg) in Cabbage *(Brassica oleracea)*

Sampling sites	Statistical indices	Cu	Cd	Zn	Ni	Pb
Mining/smelting areas N=15	Mean±Se	51.4±7.63	7.7±0.79	72.2±7.95	42.2±2.91	10.9±1.06
	Skewness	0.032	0.007	0.154	-0.146	-0.053
	Kurtosis	2.984	-0.978	2.386	1.531	1.698
	CV (%)	67.9	97.5	44.5	43.3	184.8
	Range	23.5-146	2-12	34.5-175	19-56	0.5-18
	Mean±Se	11.4±0.77	0.53±0.03	24.72±7.95	12.80±1.69	0.83±0.15
	Skewness	0.581	0.889	0.187	-0.149	1.414
	Kurtosis	1.672	-0.582	-0.323	-0.252	1.500
	CV (%)	39.6	118.2	41.3	34.2	80.0
	Range	2-15	0.5-1	5.35-33.5	4-29.5	0.5-2.5
Shapiro wilk test	p-value	0.4345[a]	0.9982[a]	0.4345[a]	0.447[a]	0.5288[a]
Independent t-test	p-value	0.011*	0.0063*	0.037*	0.207[a]	0.011*

'Two. Sided'. conf. level=.95. * = significant at $p < 0.05$; a= non-significant

Tomato: The result showed that tomato grown near the mining areas had higher concentrations of Cd, Ni and Pb compared to the concentrations in the samples from the control sites. Independent t-test showed that the means of all metals in tomato collected from both the mining areas and the control sites were significantly different at 95% confidence level except for Zn (Table 6).

Table 6: Heavy metals concentration (mg/Kg) in Tomato *(Lycopersicum esculentum M.)*

Sampling sites	Statistical indices	Cu	Cd	Zn	Ni	Pb
Mining/ smelting areas N= 15	Mean±Se	25.0±1.34	4.7±0.56	39.2±4.39	74.2±5.34	18.8±1.06
	Std. Deviation	5.218	2.175	17.0	20.68	15.08
	Skewness	-1.375	-0.338	-1.415	-0.992	-0.897
	Kurtosis	0.213	-0.673	0.234	0.277	-0301
	CV (%)	70.2	148.4	64.9	124.1	1.215
	Range	9-26	1-10	15-72	3-145	1-50
Control sites N = 15	Mean±Se	8.093±1.518	0.15±0.05	13.17±4.77	4.45± 1.05	2.49±0.75
	Std. Deviation	5.87	0.194	18.48	4.079	2.905
	Skewness	0.581	0.889	0.187	-0.149	1.414
	Kurtosis	1.672	-0.582	-0.323	-0.252	1.500
	CV (%)	78.8	164.3	1.404144	1.186	102.4
	Range	0.08 -23.50	0.01- 5.0	0.28 -52.0	0.06 56.50	0.02 20.0
Shapiro wilk normality test	p-value	0.4345[a]	0.9982[a]	0.4345[a]	0.447[a]	0.5288[a]
Independent t-test	p-value	0.001*	0.013*	0.276[a]	0.028*	0.004*

'Two. Sided'. Conf. level=.95. * = significant at $p < 0.05$; a= non-significant

3.2 Agricultural soils degree of contamination using Pollution index (Pi)

Table 7 shows significant variation in metal concentration between control sites and the sites near polluting facilities. For example, the concentration of Cu (1172.80mg/kg) compared to the concentration (109.47 mg/kg) from the control sites. The results showed a significant difference in metal concentrations for all the heavy metals for both the mining and the control sites.

Similarly, Pi for all the elements was significantly high between sites with the one for Copper being the highest. The Pollution Index (PI)ranged from 2.28 to 46.92for the samples collected near the polluting facilities compared to the range of 0.42 to 4.37 in the control site(Table 7). The NIPI values showed the same trend as PI for both sites.

Table 7: Heavy metals concentration (mg/Kg) soil Pollution index (Pi)

Heavy metals	Sampling points	Background values (mg/kg) a	Concentration (mg/kg)			Pollution index (Pi)			NIPI
			Min	Mean	Max	Min	Mean	Max	
Cu	Mi ni	25.0	418	1172.8	5160	16.72	46.92	206.4	**211.66**

Cd		3.0	2.0	7.73	22	6.66	25.76	73.3	**77.72**
Zn		70.0	134	195.20	304	1.91	2.78	4.34	**5.15**
Pb		29.2	68	153.73	258	2.32	6.68	8.83	**11.07**
Ni		75.0	100	171.33	238	1.33	2.28	3.17	**3.90**
Cu	Control sites	25.0	46	109.47	162	1.84	4.37	6.48	**7.81**
Cd		3.0	2.0	2.0	2.0	6.66	6.66	6.66	**9.41**
Zn		70.0	22	38.93	70	0.31	0.55	1	**1.14**
Pb		29.2	6	28.80	44	0.20	0.98	1.50	**1.77**
Ni		75.0	4	31.53	58	0.05	0.42	0.77	**0.87**

a=World soil background value according to (Hooda, 2010);

3.3 Bioaccumulation factor (BAF) and contamination indices of tomato and cabbage

The result showed that the BAFs of heavy metals varied significantly among the selected vegetables grown at 0.5 Km downstream of the mine polluting facilities in all the study sites. The elemental Cd was observed to have highest bioaccumulation factor in cabbage (Table 8).Generally, the values obtained for all the metals except Cu and Pb in all sites in cabbage leaves and fruits were above 0.2, thus indicating anthropogenic contamination and also high metal uptake from soil by cabbage and tomato.

Table 8: Bioaccumulation factor (BAF) of *Brassica oleracea* and *Lycopersicum esculentum*

Sampling points	**Brassica oleracea L**			**Lycopersicum esculentum**		
	Elements	Mean±Se	BAF-cab	Mean_Soil	Mean±Se	BAF-tom
Mining smelting areas (0.5 Km)	**Cu**	51.4±7.63	0.04	1172.80±298.9	25.0±1.34	0.02
	Cd	7.7±0.79	1	7.7±1.37	4.7±0.56	0.61
	Zn	72.2±7.95	0.37	195.2±16.22	39.2±4.39	0.2
	Ni	42.2±2.91	0.24	171.33±11.5	74.2±5.34	0.43
	Pb	10.9±1.06	0.07	153.7±14.70	18.8±1.06	0.122
Control sites (25 Km)	**Cu**	15.47±1.58	0.141	109.47±7.36	10.36±8.16	0.094
	Cd	1.63±0.35	0.815	2.00±0.00	0.56±0.16	0.28
	Zn	37.47±4.0	0.962	38.93±3.48	13.16±4.77	0.338
	Ni	23.27±2.06	0.807	28.80±2.95	14.25±4.36	0.494
	Pb	2.30±0.47	0.072	31.53±4.232	5.56±1.47	0.176

Table 9 shows Contamination Load Index (CLI) of vegetable samples collected from the sites located at 0.5 Km from the mining areas and from the control sites. The Contamination Load Index of vegetable samples near the polluting facility was higher than that of vegetable samples of the control sites. The samples of cabbage collected at 0.5 km from the polluting facility were observed to be contaminated by all the studied heavy metals compared to the samples from the control site where only Cd

(1.76 >1) was observed to have elevated concentration. Similarly, high CLI of Cd. Ni and Pb were observed from samples collected at 0.5 km from the polluting facility. In the control sites (25 km away from the polluting facility), the CLIof Cd and Pb in tomato were higher than the threshold limit value of 1 showing extreme contamination.

Table 9. Contamination Load Index (CLI) of *Brassica oleracea* and *Lycopersicum esculentum*

Sampling points	Elements	Brassica oleracea L			Lycopersicum esculentum		
		MPC	**CLI**	Mean±Se	**MPC**	**CLI**	Mean±Se
Mining areas (0.5 km)	**Cu**	40	1.21	51.4±7.63	40	0.62	25.0±1.34
	Cd	0.3	25.66	7.7±0.79	0.3	15.6	4.7±0.56
	Zn	60	1.20	72.2±7.95	60	0.65	39.2±4.39
	Ni	20	2.11	42.2±2.91	20	3.71	74.2±5.34
	Pb	5	2.18	10.9±1.06	5	3.76	18.8±1.06
Control sites (25 km)	**Cu**	40	0.386	15.47±1.58	40	0.202	10.36±8.16
	Cd	0.3	5.43	1.63±0.35	0.3	1.86	0.56±0.16
	Zn	60	0.624	37.47±4.0	60	0.219	13.16±4.77
	Ni	20	1.18	23.27±2.06	20	0.222	14.25±4.36
	Pb	5	0.46	2.30±0.47	5	1.12	5.56±1.47

4. DISCUSSION

4.1 Comparison of heavy metal content in soils

The observation from this study about the mean concentration of heavy metals in the soil samplesindicate that the soils within the vicinity near mining areas have higher concentration of heavy metals compared to the soils in the control sites. Similar observation was also made by Cao *et al.,* (2010), in Jiangsu, China where a rice-cultivated lands within industrial zone were found contaminated by Cd and Pb.

Within the Copperbelt Province, Zambia, other studies have observed high concentration of heavy metals in soils (Kapungwe et al., 2013; Lindahl, 2014; Ncube, 2012;Kříbek *et al*.,2010).

The decrease ofthe soil contamination degree with depth has been observed. Lindahl, (2014), observed that in Copperbelt province, surface soil samples are 10 to 50 times highly contaminated with copper than the subsurface samples. Although, pollution from mining activities such as smelting activities is the major contributor to soil pollution, other sources such as, the natural pedogeochemical background of the study area and the extensive application of inorganic compounds such herbicides, insecticides, fungicides, and other agrochemicals (Murphy and Aucott, 1998; Anawar*et al.,*2003) also do contribute towards soil pollution on the Copperbelt Province. Soil contamination is often a direct or indirect of industrial activities

(McLaughlin et al., 1999). On the average, the value observed in this study is higher than the world soil background values (Hooda *et al.*,2010).

4.2 Comparison of Bioaccumulation Factors (BAF) and contamination load index (CLI) of vegetables grown in mining areas and non-industrialized areas

The result of this study, showed that contamination levels in cabbage and tomato are higher near industrial compared to the control sites. Similar studies on vegetables grown in area close to industrial areas have reported high levels of heavy metals through bioaccumulation from soil to roots as well as aerial uptake through leaves (Kachenko & Singh, 2006).

The analysis of cabbage collected in this study at 25 km from the mine areas was also contaminated by Cd and Ni while tomatoes collected from the same sites were contaminated by Cd and Pb.It appears that Cd transfer from soil to the edible parts of the studied crops is more rapid than the other metals. Dixit, *et al.*, (2010)observed that Cd can gradually accumulate from soil to the roots, the stems and then the leaves or fruits of plants.High concentration of Cd in vegetables have been observed in Enyigba mines, Nigeria by (Orisakwe *et al.*, 2012).

The high concentration of Ni in cabbage found in this study, may be explained by the acidity of the soils of the study area (slightly acidic). However, even though Ni has been observed to be more mobile in acidic soils, it is not known to accumulate in plants or animals nor to biomagnify up to the food chain(Raymond, *et al.*, 2011).

BAF of 0.1 indicates that plant is excluding the element from its tissues while the transfer coefficient of 0.2 for vegetables indicate the chances of metal contamination by anthropogenic activities (Khan, *et al.*, 2009), and so the need for environmental monitoring of the area will be required (Sponza & Karaoglu, 2002). Since vegetables are known to take up and accumulate trace metals from contaminated soil (Khan, *et al.*, 2009), detection in tomato fruit samples were not surprising. Higher transfer coefficients reflect relatively poor retention in soils or greater efficiency of plants to absorb metals. Low coefficients reflect the strong sorption of metals to the soil colloids.

The result of this study showed that the contamintion load index showed that cabbage grown near the polluting facility were contaminated by Cu, Cd, Zn, Ni and Pb while those from the control sites were safe from contamination. Tomatoes grown both from the mining areas and the control sites were contaminated by Cd, Pb and Ni. Similar observation was made in Zarrinshahr and Mobarakeh regions, Isfahan province in central Iran by Moradi *et al.*, (2015), who observed the CLI value of heavy metals in selected crops higher than 1.In the control sites, only Cd and Ni in cabbage, and Cd and Pb in tomato were above the threshold value (CLI>1). According to Saha & Zaman, (2013), high value of CLI (CLI>1) through consumption of vegetables is detrimental to human health.

5. CONCLUSION AND RECOMMENDATIONS

The result of the study showed that vegetables grown in the vicinity of an industrial area were most contaminated. This is due to high content of metals in the soil but most importantly to the use of contaminated water released from industries for irrigation. Vegetables grown from the industrial areas were also contaminated by Cadmium. Very high metal transference from soil to cabbage and tomatoes was observed which is a concern for public health particularly for urban vegetables in which the roots, stems, stalks, leaves or fruits are consumed.

By controlling industrial and vehicular pollution of water, soil and air can prevent cadmium and lead, copper, nickel and zinc contamination. Limiting the use of wastewater for irrigation and minimizing the use of sewage sludge, fertilizers and certain pesticides can help in controlling heavy metals pollution. Farmers need to be made aware of side effects associated with certain pesticides, fertilizers and irrigation water sources during cultivation. Washing of vegetables at farm should be done with clean water. Care should be taken during the transport and sale of vegetables. The results of the present study showed that consumers are at greater risk of purchasing fresh vegetables with high levels of heavy metals beyond permissible limits as defined by the FAO/WHO (2013).

ACKNOWLEDGEMENT

My deepest gratitude goes to European Union for its sponsorship and financial assistance through the Intra-ACP programme, African for Innovation, Mobility, Exchange, Globalization and Quality (AFIMEGQ) 2016-2018 scholarship grant that supported and allowed me to undertake this research.
I am very grateful to the National Science and Technology Council, Zambia for providing financial support and the logistic to undertake the fieldwork and laboratory data analysis.
I owe my deepest gratitude to my supervisors Prof. Stephen Syampungani and Dr Concilia Monde, for their invaluable mentorship, encouragement and constructive comments on this manuscript.

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Feed Resource Availability, Livestock Migration Pattern and Synthesis of Feeding Calendar at Wag-Lasta, Ethiopia

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ABSTRACT

This survey was conducted from 2015 to 2017 to explore the pattern and reason of seasonal livestock migration, situation of different feed resources availability and seasonality at different agro ecologies of Wag–Lasta area in Amhara regional state of northern Ethiopia. A single visit formal survey, group discussion and individual interview were used during data collection. Grazing, crop residues and purchased feeds were the major feed resources with respective contribution of 56%, 22%, and 11% in the mid and lowlands of waghemira whereas 37%, 45% and 5% respectively in the highlands. Sorghum Stover followed by Tef straw were the major crop residues used at the mid and lowlands of Waghemira while barley straw followed by wheat straw and broad bean residue in the highlands of Wag-Lasta. Farmers used the residue effectively from January up to June when other alternative feed resources are not available in all agro ecologies. In the mid and lowland districts, average livestock holding were 5.62 TLU. Correspondingly, the average annual feed production from all feed sources was 6.1 tones. Based on the assumption of daily feed requirement of Farm animals, the total annual feed demand at house hold level were calculated as 12.9 tones. Thus, each house hold was under feed gap of 6.78 tons annually. In the highlands of Wag-Lasta, average livestock holding was 3.85TLU with annual feed demand of 8.7 ton and the available annual feed production was 4.5 tone thus, an average of 4.2 tone was in scarce annually.75% of the respondent at the mid and lowland districts of Waghemira were possess seasonal livestock migration while 25% were stable at their settlement area year round. The reason for migration was 95.6% for feed and 4.4% for both feed and water. 44.4%, 53% and 2.3% of the migrants were spend at the migration area for about five months, six up to ten months and for about four years respectively. Belessa, Tirari, Telajje, Tigray boarder, Dahna and Beyeda with respective migrant's percentage of 22,44,20,7,5 and 2 were identified as destinations. The distance covered during the migration were 37.8% (20-35km), 28.9% (36-60km), 24.4% (61-80km) and 8.9% (>80km).

Keywords: - Feed resource, Livestock migration, Livestock production

Citation:

Bekahgn Wondim, Mulatu Gobeze, Baye Biresaw (2019). Feed Resource Availability, Livestock Migration Pattern and Synthesis of Feeding Calendar at Wag-Lasta, Ethiopia Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-1, pp (26-40)

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Received: 25/03/2019

Accepted: 05/05/2019

Published: 10/06/2019

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1. INTRODUCTION

Livestock production which is an integral part of Ethiopian farming system constitutes a population of 56.71 million cattle, 29.33 million sheep, 29.11 million goats and 7.43 million donkeys (CSA, 2015). From the total livestock population of the country, about 40% cattle, 75% goats, 25% sheep and almost 100% of camels are raised in the rangelands (Alemayehu, 2004). For this large population, feed is the most important factor determining the productivity and marketability of livestock and its products. Feed resources as reported by Tolera and Said, (2012) can be classified as natural pasture, crop residue, improved pasture and forage and agro industrial by-products of which the first two contribute the largest share. The author have also described that fibrous agricultural residues contributes a major part of livestock feed i.e., about 50% of the total feed supply in Ethiopia. Under smallholder livestock production system, animals are dependent on a variety of feed resources which vary both in quantity and quality and the available feed resource should match with the number of animals in a given area. Livestock production is constrained by ecological, technical and economic limitations which result in severe feed shortages. Despite the fact that smallholder mixed crop-livestock farmers use diverse feed resources, inadequate and poor quality feed supplies continue to be major challenges. Market-oriented livestock development can only be realized once the technological, organizational and institutional opportunities and challenges are properly documented and innovative approaches to feed development and improvement approaches and metrics are identified and implemented.

Wag- lasta area which is located at the northern part of Ethiopia is characterized by low input subsistent mixed crop livestock farming. The area is the home for Abergelle goat breed belonging to rift valley family. It has an estimated population of over 300,000; widely distributed along the Tekeze River in Southern Tigray (Tembien and Inderta), Waghimra, Raya Azebo, and North Gondar (Simien) kept by the Agew and Tigray ethnic groups (Farm Africa, 1996). The area is known for erratic and short rain fall distribution, less available or dispersed watering points and poor pasture/browse distributions with poor availability and quality. As a result of the above factors or seasonal changes, communities move their animals for long distance and time period in search of feed and water during dry seasons. Therefore, it was thought worthwhile to document the available feed resources, season of availability, utilization and understand seasonal livestock migration pattern and develop appropriate adaptive measures to combat the above problem in the area. In view of these perspectives, this survey was conducted to assess Livestock migration pattern, feed resource availability, seasonality and utilization using feed assessment tool (FEAST) to determine the potential of site-specific feed interventions and options in the areas.

2. MATERIAL AND METHODS

2.1 Description of Study Area

The study was conducted in seven districts representing low land (Abergelle,Ziquala and Sehala), mid land (Sekotazuria) and highland (Lasta, Dhana and Gazgibla) of Wag- Lasta districts of Amhara regional state of northern Ethiopia. The districts are located at 618-850 k.m north east of Addis Ababa, 500-550 km south west of the center of Amhara regional state and 65-128 k.m north and south west of Sekota town. Some of the districts (Sekotazuria, Abergelle and Sehala) have a national boundary of over 200k.m with Tigray regional state. The mean annual temperature, mean annual rain fall and altitude of the districts were 21.6 -28 ^{o}c, 300-700mm and 1100-2600masl respectively (Metrological data and personal observation, 2017). The rain fall distribution was very erratic with short rainy season of from June – August at the mid and low land districts of Wagehemira while better rain fall distribution were observed from Jun to August and short rain during May at the highland districts.

2.2 Sampling Technique

From each district of mid and low land agro ecologies of Waghemira administrative zone where seasonal flock migration was very common, two kebeles were selected purposely. For feed availability assessment, two kebeles were selected randomly from each district from the three agro ecologies of Wag-Lasta. Economic level of the respondents (low, medium and high economic class) in terms of land and livestock holding was considered during the FGD and individual interviewee selection from the sample kebeles.

2.3 Data Collection Method

Participatory rural appraisal (PRA) and individual interview were the approaches for data collection. Semi structured questionnaire type were used during interview session. 12 farmers with house hold role by consideration of all land holding categories and with consideration of equal involvement of women were used for the focus group discussion and 3 farmers from each land holding category which is a total of 9 farmers were further used for the individual interview session at each kebele (according to ILRI FGD and individual interview guide for FEAST). A total of 168 respondents from 14 kebeles were selected for the focus group discussion and 126 respondents were further used for the individual interview session. The group discussion and individual interview sessions were focused on general farming systems, livestock production systems, feed resource availability, seasonality and utilization. During the FGD and individual interview sessions, for the districts (Abergele, Ziquala, Sehala and Sekota zuria) where seasonal livestock migration was very common, data related with seasonal livestock migration was collected. While from the whole sample kebeles, data on feed resource availability, seasonality and

utilization were collected. Correspondingly, GPS coordinate points for study kebeles, settlement areas and migrants destination were taken.

2.4 Data Collected

The types of data collected from this assessment were: Socio economic characteristics of respondents, farming system records, season of livestock migration, reason of migration, species under migration, GPS coordinate points along the study kebeles, destination routs, watering points, settlement areas, pasture/browse area points, type of feed resource available and season of availability.

2.5 Some Standard Measurements and Classifications Used

To classify the districts in agro ecological bases, standard altitude classification range were used as:

Low land—500 to1500 masl
Mid land ---1600 to 2200 masl
Highland---2300 to 3700 masl

The Standard unit TLU (Tropical livestock unit) was used for livestock number quantification throughout this paper 1 TLU=250 kg. (Harvest, 2011).
The annual maintenance feed demand for 1TLU was estimated 2.3 tone on dry matter basis (FAO, 1987)

2.6 Data Analysis

Quantitative data collected during individual interviews and FGD were analyzed using feed assessment tool (FEAST) Excel macro program (www.ilri.org/feast) and descriptive statistics. Livestock migration data were computed with descriptive statistics, GIS were used for mapping the roots of livestock migration

3. RESULTS AND DISCUSSION

3.1 Major Farming Practices and Resources

As shown in Fig.1, the landholding status of Households under different agro-ecological categories were identified as; in the mid and lowland areas large land holding (19%), medium land holding (39%) and low land holding (42%).While at the highlands, large land holding (27%), medium land holding (53%) and low land holding (20%). The result revealed that relatively better land holding were seen at the highlands of Wag- Lasta than mid and low lands of Waghemira had which was in contrary from the report of (Dere, Mekdim , Alemayehu and Taffesse, 2012); land holding at the highlands of Ethiopia is lower than the low lands as the highlands have relatively better rainfall distribution and suitability for farming than lowlands. The disagreement might be associated with the reason that livestock production, especially goat production was an important part of the livelihood system at the mid and lowland districts so that farmers went towards those areas for such farming activity and at the same time the need for agricultural land increased and land holding

became diminished. In another way, most of the highland areas covered by this study were degraded, sloppy and not suitable for agriculture as a result of this the computation for land was lesser and farmers were participating in off farm activities.

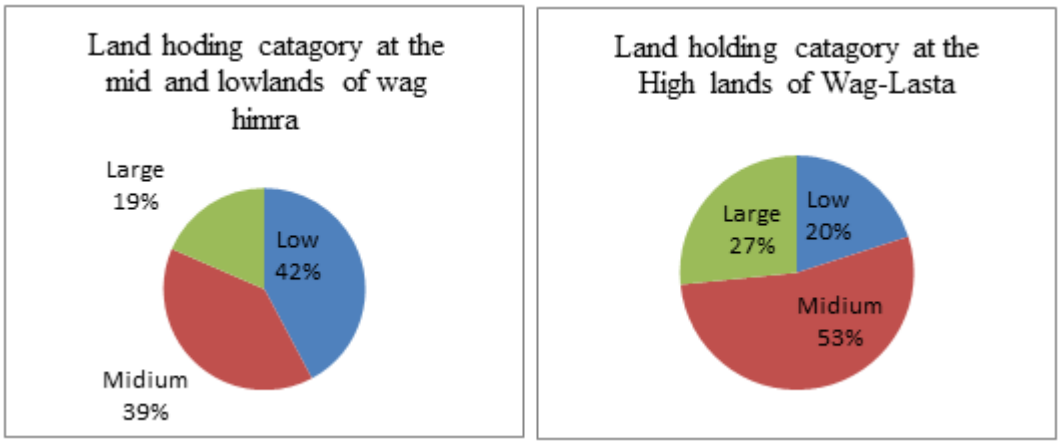


Fig.1 Land Holding Category

3.2 Livestock holding and crop diversities

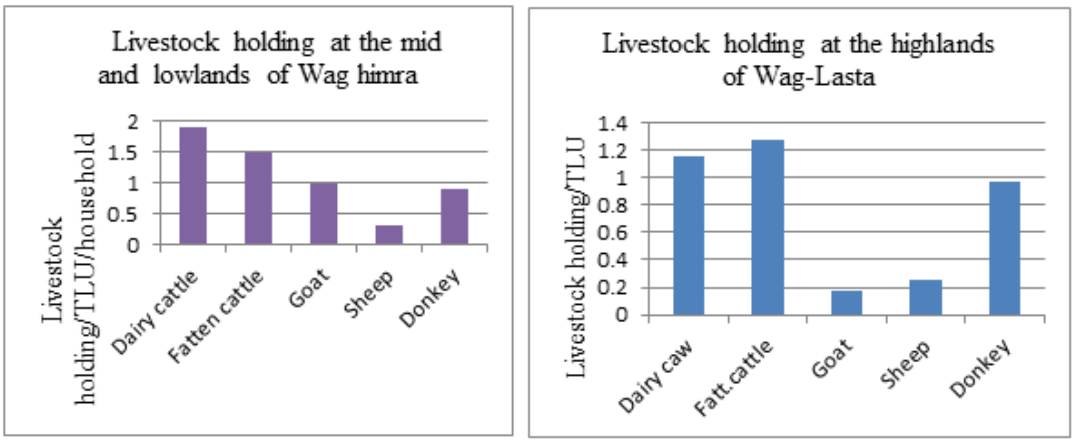


Fig.2 Livestock Holding

The survey explored livestock holding per household (TLU) and found for goat, sheep cattle and donkey as 1, 0.3, 3.4 and 0.9 respectively at the mid and low lands of wag hemira while 0.18, 0.26, 2.42 and 0.97 for goat, sheep, cattle and donkey, respectively at the highlands of Wag- lasta. The result showed that together with cattle, goat was reared very dominantly (1TLU) per household at the mid and low lands of Wag hemira while at the highlands of Wag-Lasta, sheep was in better holding per house hold (0.26 TLU) which clearly much with the reality of niche of the species as goat better suit the low lands and sheep in highlands ESGPIP, (2009).

The result was a bit lower from the report (1.62 TLU) per house hold of Goat holding at Ziquala district (Alubel, 2015). The discrepancy of findings might be associated with sample size; this survey had covered larger scope than the result reported by the above author.

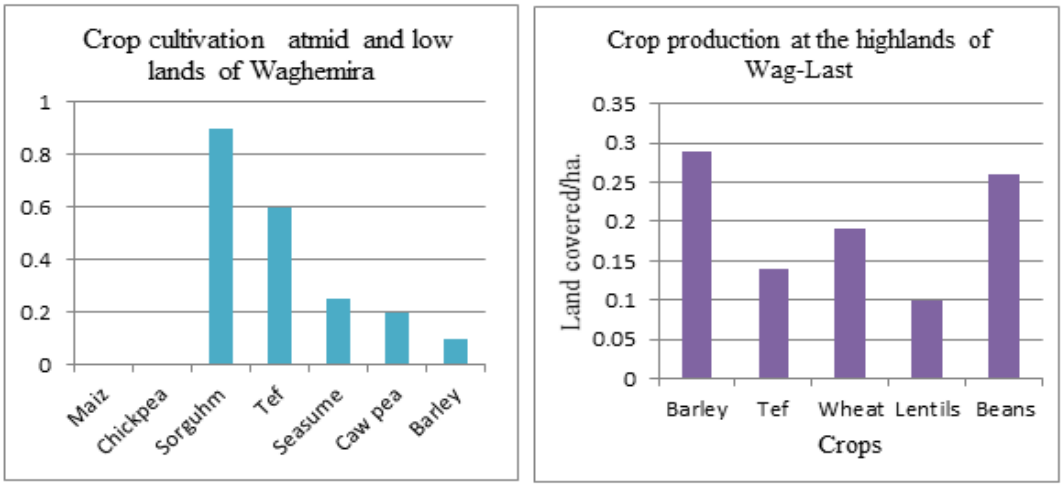


Fig.3 Crop Diversities

Besides livestock, crop cultivation was an important part of the small- holder's livelihood with the dominant crop varieties of sorghum, tef, sesame and local cow pea with respective per household production of 0.98, 0.58, 0.225and 0.22 hectares at the mid and low land areas of Wag hemira while barley, tef, wheat, lentle and broad beans of 0.29, 0.14, 0.19, 0.1 and 0.26 hectares respectively at the highland districts of Wag-Lasta. The mixed livestock crop production system observed in this study revealed that smallholder farmers could derive livestock feed resources from such crops to compliment gazing and browsing. Apart from crop production, farmers specially at the mid and lowlands of Waghemira where frequent rain failure is very common, cultivate food crops in target of crop residue production for their animals and most of the time its common that farmers are going to harvest the food crops at vegetative stage and store as crop residue for further use for their animals.

3.3 Source of income and livestock marketing

The assessment indicated that in all of the agro ecologies income were made from livestock, crop and family labor for the households. In annual basis, the cash contribution of livestock sell for small holder farmers regardless of total livelihood contributions was 75% and 44% at the low and midlands of Waghemira and highlands of Wag-Lasta areas respectively. The result was slightly differed from a report (53%) cash contribution from the livestock sector at ziqual district (Alubel, 2015). The difference might be associated with sample size; this survey had covered larger scope than the result reported by the above author. The result also showed that in exception from other livestock species, goat were the most liquid form of income

source sold year round by the farming community. The reason for this year round selling might be associated with presence of wider involvement of goat traders, active goat marketing along Wag-Tigray market outlet and presence of goat meat processing and exporting abattoirs at Mekele town. Out of the total cattle sold per year in household level, 60% of cattle were sold from January up to June which indicates farmers destock their herd during feed scarce seasons with selling price of up to 297 USD and 27% of the cattle were sold from September up to December; for the reason that during this season animals are relatively in good body condition these can be sold with better price of up to 327.9 USD while 13% were sold from July up to august. During this season cattle selling were low indicating farmers need to stay with their animals unless there is feed shortage.

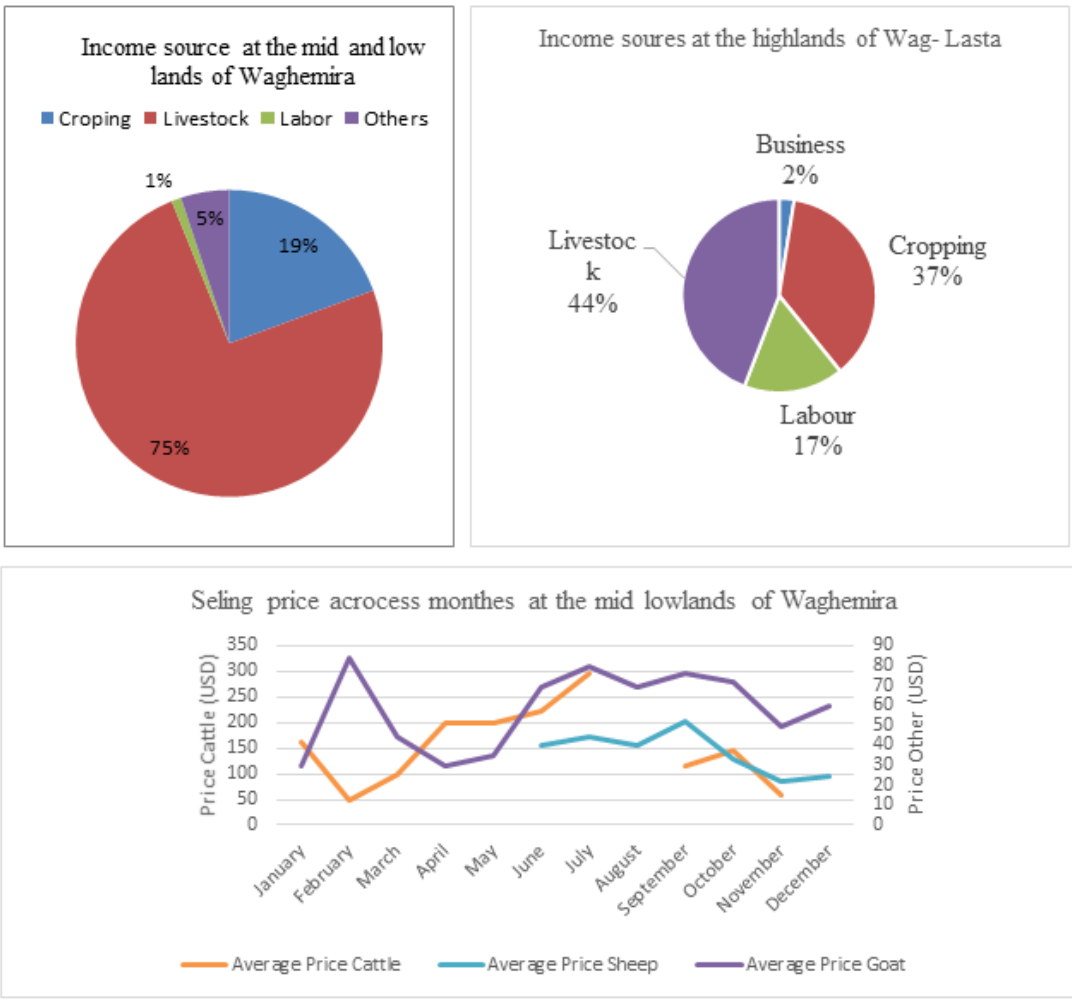


Fig.4 Source of Income and Livestock Marketing

3.4 Major feed resources availability and management practices

The major feed resources available in the study districts are presented in table 1 below.

Table 1. Estimated Feed Production/Tons/Year in Dry Matter at Household Level

Districts	Grazing	Improved fodder	Crop residue	Purchased feeds
Abergele	4.42	1.57	0.93	0.43
Ziqual	2.98	0.74	0.58	0.92
Shala	1.83	0.79	0.18	0.41
Sekota zuria	4.2	2	0.26	0.55
Dhana	1.78	0.5	1.85	0.436
Gasgibla	0.35	0.02	0.2	0.108
Lasta	**1.14**	**0.152**	**1.26**	**0.094**

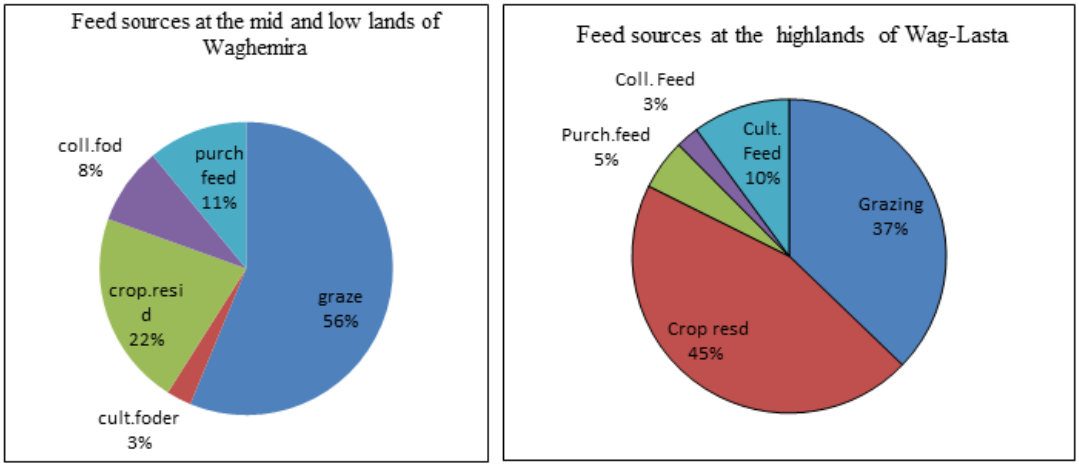


Fig. 5 Major Feed Resources

As summarized from the FGD and individual questionnaire and estimated using the Feast excel macro program, the contribution of grazing lands to livestock feeding was 56% in the mid and low lands of Waghemira and 37% in the highlands of Wag-Lasta districts which was a bit in line with the report (ranges from less than 25 to 50%) on feed resource availability and utilization at central and eastern Tigray (Yayeneshet, Abrehaley, Dawit and Haile 2016) and (55.7%) on range land condition and feed resource in Metema district of northern gondar (Azage, Lisanework, Tesfaye and Worku, 2007). As shown in table1, gazing contributed much in its dry matter basis per year in comparison with other feed sources in the mid and lowland districts (Abergele, Sekota zuria and Ziquala). This might be the reason that the mid and low land areas have relatively vast communal grazing lands than the highlands had.

The overall contribution of crop residues was 22 % in the mid and low lands of Waghemira and 45% in the highlands of Wag-Lasta districts. This is in line with the report that shows about 50% contribution of crop residues; on feed resource availability and utilization in central and eastern Tigray (Yayeneshet, Abrehaley, Dawit and Haile 2016). However, this result is different from the above report in the case of mid and lowlands of waghemira of which the difference might be associated with productive land shortage and unfavorable ecological condition for crop production in the the mid and lowlands which in turn yield low crop and residue production. Nevertheless, these results are in line with the report demonstrating about 20.7% contribution of crop residue in livestock feed in Metema district of north Gondar (Azage, Lisanework, Tesfaye and Worku, 2007). Except in few cases, practice of improved forage production and utilization was minimal in the study area which needs more to be done on introduction and extension of forage varieties in the areas. The figure below shows the different feed sources and utilization in the study areas.



Fig. 6 Major Feed Sources and Management Practices

3.5 Seasonality of major feed resources

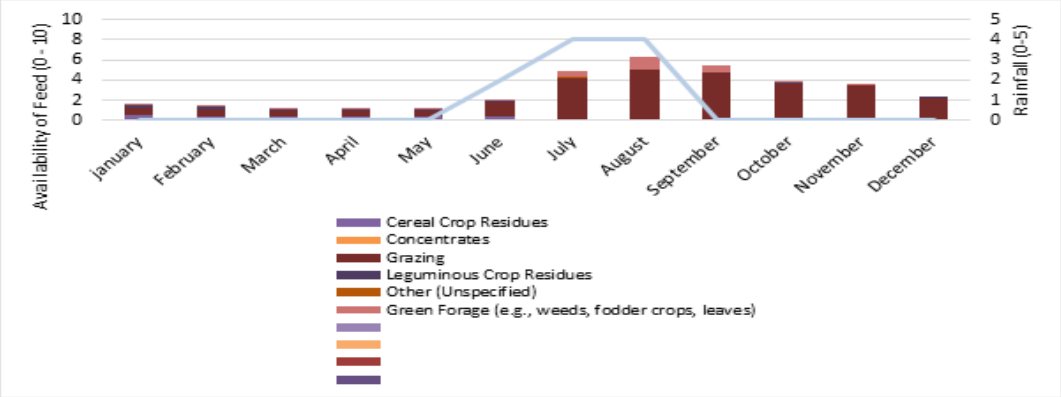


Fig.7 Feed Resources Availability across the Mid of Months and Low Lands of Waghemira

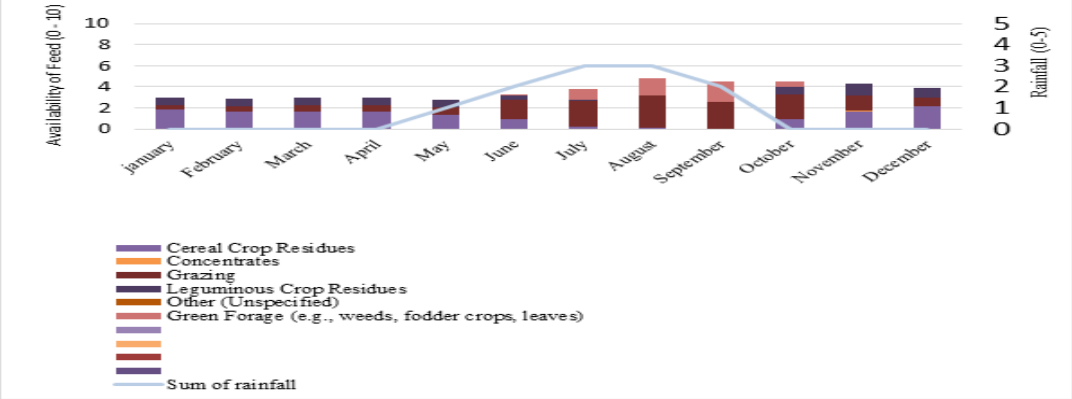


Fig. 8 Feed Resource Availability across Months at Highlands Of Wag- Last

The results show that in each month, feed sources were used in combination; from January to May. Livestock feed was complimented predominantly from cereal and legume crop residues and from grazing in all of the agro ecologies. While from June to September, livestock feed was obtained mainly from grazing and green forage, weeds and different fodders in all of the agro ecologies. This indicates that in this season, there is relatively better rainfall distribution in the areas; as a result animal feed can be available from grazing lands and weeds and different fodder can be harvested from the cropping activities. From October up to December, in all of the agro ecologies, feed from grazing was in more abundance with some supplementation of cereal and legume residues. During all the seasons, grazing together with crop residue were an important sources complimenting the livestock feed in the areas which is in agreement with Alemayehu (2004), Tolera, (2007) and Gashu, Geremew, Tegene and Aster (2017) who reported natural pasture and crop residues to be the major feed resources for highlands of Ethiopia. These all combination of

animal feed sources indicate that each source was not abundantly found and farmers used the residue very effectively from January up to June when the graze lands becoming less abundant and other alternative feed resources were either not available or expensive in all agro ecologies. This calls for increasing attention to improve feeding value using different options as Crop residues are characterized by low digestibility.

For feed resource availability assessment in all of the agro ecologies, ten indices were used as 1= extremely low and 10= extremely high feed availability in the areas (according to ILRI guide for Feast). Access for feed resources in the mid and lowlands of Waghemira was two from January up to May and four from June up to December. While at the highlands of Wag- lasta, the access for feed resources from ten were three during January up to May and five during June up to December. These results clearly show that the highlands had relatively better feed production potential as they had better rainfall distribution and crop cultivation pattern than low lands in the present study areas. The result are in agreement with the report of Yayeneshet, Abrehaley, Dawit and Haile (2016) on feed resource availability and utilization in central and eastern Tigray.

3.6 Feed Balance Analysis

Based on the total feed production presented above, indicative feed balance was calculated at house hold level for the three agro-ecologies of seven districts of Wag-Lasta. The average livestock holding per household at the four mid and low land districts of Waghemira were 5.62 TLU and the average annual maintenance feed demand of 1TLU was estimated 2.3 tone (FAO, 1987) Based on this assumption, the total annual feed balance per house hold was calculated as 12.9 tone and the average annual feed production from all feed sources was 5.5 tones with an average annual feed purchase of 0.6 tons per household. As a result, each house hold was under feed gap of 6.78 tons annually which is equivalent with six months. Thus, livestock keeper in the areas tried to cop up this serious feed shortage problem either by migrating to distant areas in search of better feed resource or by under feeding of that limited feed resource. Similarly, in the highlands of Wag-Lasta, the average livestock holding in household level were 3.83 TLU and the total feed production from all feed sources annually was 4.25 tons based on the above calculation, the annual feed demand in household bases was 8.85 tons which calls each household were under feed gap of 4.3 tons annually equivalent with around four months. The result was in line with the report of about four months feed gap (Yayeneshet, Abrehaley, Dawit and Haile 2016) in central and eastern zones of Tigray and negative feed balance report in Wolayita Sodo, Alaba District and central Rift Valley of Ethiopia (Admasu, 2008) and (Wondatir, 2010) .

3.7 Seasonal livestock migration

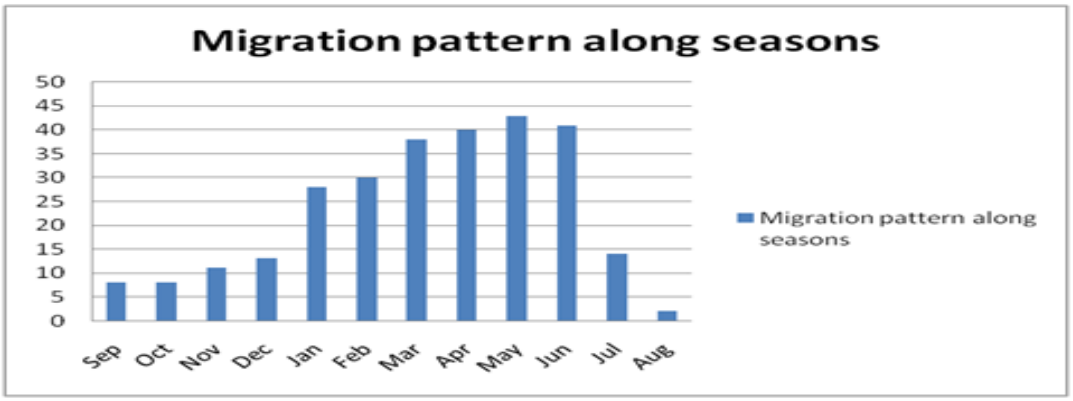


Fig.9 Livestock Migration Pattern along Months at Mid and Low Lands Of Waghemira

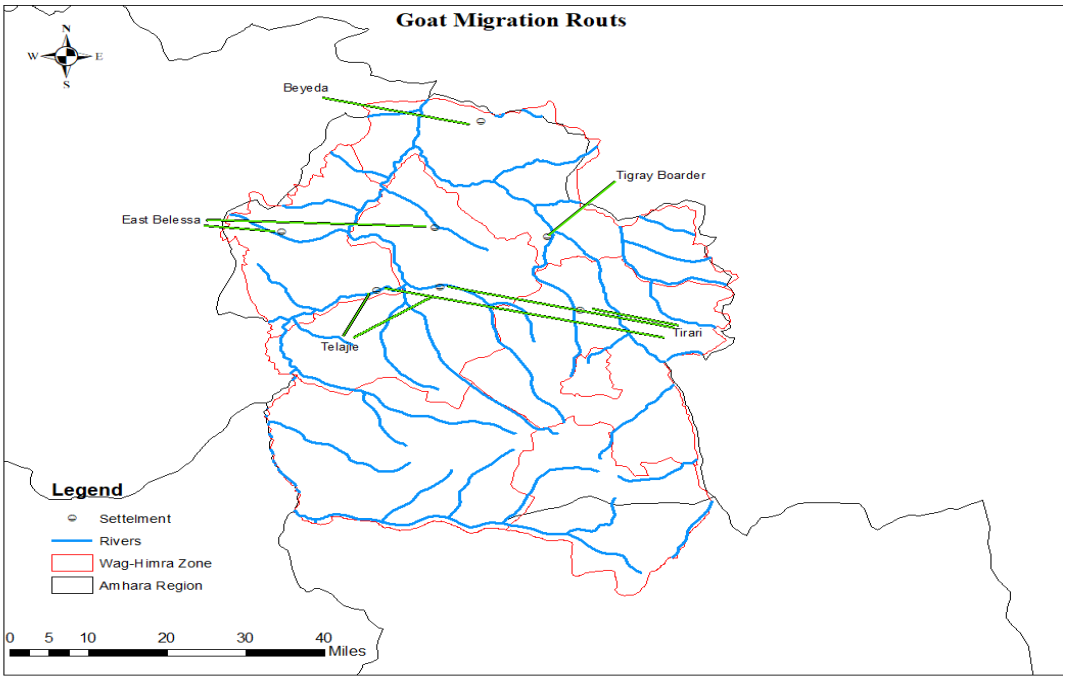


Fig. 10 Livestock Migration Routes and Settlement Areas

The result revealed that, migration was very common from January up to June in the mid and low land districts of the study area and 75% of the respondents were agreed as they were under seasonal migration with their animals while 25% were stable at their settlement area year round. The reason for migration was 95.6% of cases for feed and 4.4% of cases for feed and water. Thus Feed shortage was found to be the driving factor for seasonal livestock migration with owners in the study areas which is in agreement with the report of Mounir and Sarker, (2015) on livestock migration

in the arid areas of India. For long distance migration, mostly the male family heads from the villages go in group with their animals and may stay for months up to their settlement areas can produce better feed for their animals. During the migration, donkeys were important for carrying the owner's food. Wives and elder sons had responsibility of handling and managing farming activities around their home till the house hold head come back. While for short distance and for short period of migration, mostly sons were assigned to be went with the animals as an attendant. Cattle (10.87%), goat (10.87%), sheep (7%) and all species together (78.26%) were the identified species under seasonal migration.

Out of the of the total, migrants, about 44.4% , 53.3% and 2.3% were stayed at the migration area up to five months, ten months and four years respectively. Moreover, the distance covered during the migration was about 20-35 km (37.8%,), 61-80km (28.9%) 36-60km, (24.4%) and (8.9%) >80km respectively. This is a bit higher than an earlier report which has shown about 18- 22km travel in search of water and feed at the arid areas of India (Mounir and Sarker , 2015). According to the result obtained from FGD and individual interview, six sites were identified as potential destinations for the migrants viz., Belessa,Tirari, Telajje, Tigray boarder, Dahna and Beyeda with their respective migrants percentage of 22,44,20,7,5 and 2. According to the respondents as is depicted in our observation, the reason for choosing these areas were availability of vast communal grazing lands with better feed availability year round and water was available at the areas as major rivers (Tirari, Zamira, Tekeze and menna) were crossing the areas.

4. CONCLUSION

Livestock production is constrained by many of the factors like feed sources. Grazing and crop residues were identified as the major feed sources for livestock in the study areas. The development and wide use of improved forage species were negligible in the areas. From January to June, crop residue was fed very dominantly when grazing lands becoming less supporting which calls for improving the quality of crop residues through different treatment technologies. Minimal trend of purchasing animal feed during scarce seasons and destocking of the herd/flock during dry season were identified as the common farming practices of livestock keepers in the areas. From the feed balance calculation made in the areas, livestock were under feed gap of (6.78 tons) and (4.3 tones) in mid and low lands of Waghemira and the highlands of Wag-Lasta areas respectively; thus a lot is needed to be done to improve the present situation.

To cope up the prevailing feed shortage, livestock keepers adapt seasonal migration with their animals and six major places have been identified as their potential destinations (Tirari,Belessa, Dhana, Tigray,Telajje & Beyeda). Therefore, as mitigation option of such serious scenario, proper feed resource development and strategic plan need to be drafted and implemented beyond the research and extension bodies so as to design and implement sustainable feed resource interventions in the areas.

5. RECOMMENDATIONS

As grazing lands are the major sources of livestock feed at the areas, there is an imperative need to actively work on pasture improvement by designing appropriate intervention plan together with community members and local administration. Improved forage development and crop residue improvement research out puts should be urgent tasks for research institutions and extension bodies for filling the existing feed gap problems By working much on market issues, flock/herd destocking during dry seasons needs to be promoted as an important approach of feed gap copping mechanism by livestock keepers. Feed development and marketing business need to be promoted as an important mitigation option of feed gap problem Further study on the livestock migration pattern need to be done for the highlands of Wag-lasta as this study has coved only the mid and lowlands of Waghemira zone.

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DIJBAR
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Volume-1 Issue-1

Reading and Writing the World with Statistics: Critical Understanding for Social Justice

Mulugeta Woldemicheal Gebresenbet (PhD)*

ABSTRACT

This study addresses the need to develop secondary students' critical understanding of descriptive statistics for social justice. Students worked on non-routine problems called Model Eliciting Activities, which require students to make interpretation and conclusion of meaningful real life situations. The modeling lessons had four Model Eliciting Activities (Safe Water, Millennium Dam, Football & Tourist) so as to allow students to 'express, test and revise' their models iteratively in an engineering way in multi-disciplinary areas. The objective of the study is to explore how can students develop critical understanding with the aim of living together in the world that is 'survival with dignity' using a pedagogy of Modeling Approach on cross cutting issues of a society on a unit of descriptive statistics. Quality Assurance Guide instrument was used to assess students' models on Model Eliciting Activities. A transformative study design was used to look into students' critical understanding qualitatively. Descriptive statistics and content analysis were used to analyze the data on students' reports on Model Eliciting Activities and on projects. Though students found Model Eliciting Activities cognitively challenging tasks, they constructed different models working in a team collaboratively towards social justice. In conclusion, the findings of the study showed students more likely can enhance their critical understanding of descriptive statistics towards social justice working on relevant non-routine tasks like Model Eliciting Activities and doing projects on their own themes.

Key Words*:* Statistics, Modeling Approach, Model Eliciting Activity and social justice

Citation: Mulugeta Woldemicheal Gebresenbet (2019). Reading and Writing the World with Statistics: Critical Understanding for Social Justice. Daagu International Journal of Basic & Applied Research-DIJBAR. Volume1, Issue-1, pp (41-57)

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Received: 25/02/2019

Accepted: 15/04/2019

Published: 10/06/2019

OPEN ACCESS

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1. INTRODUCTION

Modeling is getting recognition in Mathematics Education for advancing students' understanding of a concept (Doerr & Lesh,2003), (Sriraman & English,2010). However, little is known about Socio-critical Modeling that uses mathematics or statistics as a critical tool for analyzing and solving socio-cultural problems. A Modeling Approach in the study integrates Contextual and Socio-critical Modeling Perspectives for teaching statistics through problem solving and, therefore; justifies the statistics rather than treating it as a means to an end.

The nature of problems beyond classroom demands educators to give students interdisciplinary problem solving experiences. Here is an important question to ask: 'How far do the problems which exist in textbooks help to achieve the above aims?' An ongoing debate in mathematics education for several decades pertains to the extent to which low-level to high-level activities should be used (Chamberlin,2008,p.1), (Chamberlin, 2010, p.52),(Schoenfeld,2004). Analysis model is suggested by (Chamberlin, 2010, p.52) for decision making for teachers to select problem solving tasks for low level and high level learners. Based on this model, the content analysis is made on the current Ethiopian Grade Nine mathematics textbook on statistics unit which is published by Ethiopian Ministry of Education in 2010.

The percentages of exercises and word problems tasks in statistics unit in Ethiopian Grade Nine mathematics textbook are 68% and 27% respectively. Although Ethiopian education policy and documents on mathematical curriculum recommend that there should be relevant problem solving activities on socio-cultural issues, the percentage of statistical problem solving tasks (4%) in Grade 9 textbook is very low and non-routine statistical problem solving tasks are almost non-existent. Researchers have indicated that covering the text book is the most common teaching practice in Ethiopia instead of engaging students with rich problem-solving tasks (Asgdom,2009).

This may lead teachers to use simple textbooks problems and as a result, students couldn't develop cognitive abilities to solve problems in novel situations. Furthermore, students need to develop their critical understanding of statistics to solve socio-cultural problems. A study by (Asgdom,2009) has found that the practice of Ethiopian Education mostly focuses on knowledge acquisition, or what UNESCO calls "learning to know," to the detriment of other useful purposes, learning to do, learning to be and learning to live together.

The central aim of Socio-critical Modeling is developing students' critical understanding of the surrounding world with emancipator perspective (Kaiser & Sriraman, 2006). This perspective emphasizes the role of mathematics in society and claims the necessity to support critical thinking about the role of mathematics in society.

This study was conducted at West Oromia Region schools (School A and School B; pseudonyms) in Ethiopia based on grade 9 secondary mathematics school curriculum

which had one unit of descriptive statistics with 22 period allotments. The researcher choose this research site for a number of reasons. First, the researcher had familiarity of the study site living at the place for more than 15 years to investigate the nature of socio-cultural problems that could arise from their everyday life. Second, the study selected the two schools to show direction how it was possible to work jointly to improve the quality of education. Third, the distance between the two schools is 0.5 km, which could make the data collection process convenient.

2. MATERIALS AND METHODS

This section presents the research approach and methods used to investigate secondary students' critical understanding of descriptive statistics using a Modeling Approach. This study is informed and shaped by the theoretical influences of Contextual Modeling and Socio-critical Modeling perspectives. Given the purpose and context of the study, recognizing the theoretical research framework provides structure for explaining and justifying the usefulness and appropriateness of a study. A transformative qualitative design with a lens of two modeling perspectives was used.

2.1 Research Approach and Design

The research problem of this study led a transformative qualitative research design to be utilized. The rationale for choosing the research approach is the nature of the research question: How do students can develop their critical understanding working collaboratively on modeling activities and doing projects? For explaining the intervention (the Modeling Approach), case study design was used based on the data that included students' solution artifacts on Model Eliciting Activities (MEAs) and documents of students' projects. The case study design involved embedded multiple-case design. The case study used was explanatory type to answer the how research questions on students' critical understanding of descriptive statistics using Modeling Approach. The unit of analysis in this study was classroom practice of modeling approach, individual and teams of students who participated on the intervention to investigate how students' enhance their critical understanding of descriptive statistics.

2.2 Sampling Techniques

From the two high schools, 80 students participated in this study from two grade 9 sections. The sampling method used to select the two classes was purposive sampling. Two teachers were selected one from school A, and the other from school B based on their willingness to participate in the research. In both schools, one class of students was taught using Modeling Instructional Approach. The sampling strategy to select the participant for the interview was purposive sampling. Twelve interview participants were selected for interview on the students' projects. Students were sent an informed consent to participate in the interview based on the following criteria. The first criterion was students' achievement levels based on the pervious semester mathematics result so that students at low, medium and high achievement levels would be included in the

interview. The second criterion was sex of the student to capture some of female students' experiences on the Modeling Approach. The third criterion was on the place where the students live, rural or urban.

2.3 Instructional Design for Modeling Approach

Four MEAs were designed for this study as described in Table 1 based on the six principles of constructing MEAs (Doerr & Lesh,2003) with other statistical activities using representation systems. The MEAs had four main components: newspaper article, readiness or warm up questions, data table, and a problem. Each component serves a valid purpose and used to engage problem solvers in the task. MEAs have components, which can help students to be engaged by reading and writing the world with statistics.

Table 1. Descriptions of the four Model Eliciting Activities

Title of MEA	*Problem Context*	*Statistical Concept*	*Objectives with Social Agency*
Safe-Water	Students are asked to write a report based on 20 households data to give an awareness program for rural people how to drink safe water and keep their environment sanitation and hygiene.	Different graphs, distribution, average, little or a lot variability	To provide awareness on health and sanitation problems
Football	Students are asked to write a report to present on school min media to create awareness program and for consulting the Ethiopian football coach based on data on two football teams who plays against two other African football teams.	Center(mean, mode, and median), Distribution, Graphs	Helping others to control emotions and for creating awareness program about Ethiopian Football
Millenniu m Dam	Students are asked to write a report based on three grade 9 sections of students' data on the contribution of money to Ethiopian Millennium dam which is going to be sent by the director for the news agency.	Outliers, measure of centres (mean, median and mode) Range	Empower students on their contribution for developing their identity
Tourist	Students are asked to give reliable information based on the weather data of five tourist sites on what to eat, cloth and shoes to wear.	Distribution , measure of centre, measure of variation	Use variability in everyday life like knowing variability of weather conditions

The purpose of the newspaper was to familiarize students with the context of the problem and to develop their statistical literacy. This article required 15 minutes or so to read and provide further information for the second part of MEAs. The second part of an MEA was readiness questions or warm-up questions. These questions were designed to evaluate their understanding of their reading and basic statistical literacy ability of the media article. The third part of MEA was a problem statement, which

required students pose and solve problems on the socio-cultural problem situations. The fourth part of an MEA was usually a data table that may be used to solve the problem. After finishing the MEA, there would be other follow up activities that used system of representations and MEA extension problems.

2.4 Instruments of Data Collection

Based on the modeling cycle, a worksheet with the following probing questions were prepared and given for the students: What is the thing that the client wants you to do for him/her? How could you use the data using your model so that it is meaningful for the client purpose? Could you show how to use the statistical models to provide some solution for the problem? What are your interpretations on the models you made in question three? Do you think your statistical models enough for the client purpose and have limitations? Write your team report/letter/news.

The quality assurance Guide was designed to help teachers, researcher and students evaluate the products that were developed in response to the MEAs with the following characteristics: (a) the goal is to develop conceptual tools, (b) the client purposes are known and met, and (c) the tool must be sharable with other people and must be useful in situations where the data are different than those specified in the problem as shown in Table 2.

The Quality Assurance Guide was used to quantitatively assess students' models. The levels were designed to categorize how well students' solution artifacts or reports satisfy the needs of the client and how well they explained their reports in general way. The range of response went from level 5, where the response satisfied the needs of the client for the current situation and for other similar situations as well level1, where the response were going in the wrong direction and the team would need to rethink their reports completely.

Table 2. Quality Assurance Guide

Performance Level	How useful is the product?	What might the client say?
Level one: Require Redirection	The product is on the wrong track. Working longer or harder won't work. The students may require some additional feedback from the teacher.	*"Start over. This won't work. Think about it differently. Use different ideas or procedures.*
Level two: Require Major Extensions or Refinements	The product is a good start toward meeting the client's needs, but a lot more work is needed to respond to all of the issues.	*"You're on the right track, but this still needs a lot more work before it'll be a form that's useful."*
Level three: Require only Minor Editing	The product is nearly ready to be used. It still needs a few small modifications, additions, or refinements.	*"Hmmm, this is close to what I need. You just need to add or change a few small things."*

Level four: Useful for this Specific Data Given	No changes will be needed to meets the immediate needs of the client.	*"Ahhh, this will work well as it is, I won't even need to do anything".*
Level five: Sharable or Reusable	The tool not only works for the immediate situation, but it also would be easy for others to modify and use in similar situations	*"Excellent, this tool will be easy for me to modify or use in other similar situations-when the data are slightly different."*

For observing classroom practice, *Teaching for Robust Understanding in Mathematics (TRU Math)* classroom analysis scheme was used with permission (Schoenfeld, 2013, p.607). TRU Math rubric contains five general dimensions (the mathematics, cognitive demand, access, agency and assessment) of classroom activities. The TRU Math scheme comprised an analytic framework for characterizing essential dimensions of mathematics classroom activity and a scoring rubric for capturing their presence in instruction. Classrooms observation of the four MEAs was analyzed using the five minimal overlapping dimensions with three episodes for the MEA activities as shown in Figure 1. A typical MEA session involves the three distinct phases, which is used as episodes to analyze the classroom observation data. If an episode was greater than 10 minute, the weighted average score of two or three episodes was assigned in each phase based on the TRU Math rubric. The rubric was used as a framework taking observation note because, according to (Schoenfeld, 2013, p.607) the five diminishes can help teachers and researchers to characterize the modeling class in simple and easy language.

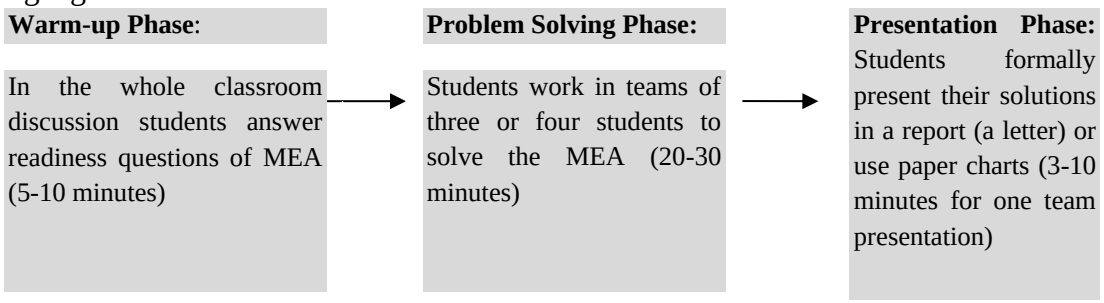


Fig.1 MEA Activities

The students wrote four homework assignments describing their work in each of the statistical investigative activities in their project works. The students consulted the teacher after completing each homework assignment to do the next stage of the subsequent homework. The homework assignments for the statistical investigation part were as follows: (1) formulating a question; (2) collecting data; (3) analyzing the data and interpreting the results; and (4) writing and presenting the final project report.

These four components provided the students a scaffolding structure to do the project. The projects were conducted by team of three or four students for six weeks.

Table 3: Four phases of the investigative project

Homework Assignment	Description of Students' writing Assignment
Formulating a Question (1-2 pages and 1 week)	2-5 research questions and a rationale for the project; students should select the topics by their own;
Collecting Data (1-2 pages and 2 weeks)	A description of how they collect data and the sample size. Students should use real data;
Analyzing the data and Interpreting the results (3-6 pages and 2 weeks)	Show 2 or more visual display of data and use measure of central tendency and variation;
Final Project (3-12 pages and 1 week)	Compilation of their previous assignment into the following: Introduction, Body and Conclusion and present their project report to students and teachers.

3 RESULTS AND DISCUSSION

3.1 MEAs Classroom Observation

The four MEAs were observed with minimum non-overlapping dimensions based on TRU Math rubric. The maximum score on TRU Math rubric is 3 and the minimum is 1. The scores of the four MEAs using weighted average were shown in Figure 2 for the two schools on the five dimensions of TRU Math rubric. The crossed inter-rater reliabilities for the four MEAs for the two respective schools were the following: MEA-1, 0.90, 0.87; MEA-2, 0.81, 0.82; MEA-3, 0.83, 0.77; MEA-4, 0.89, 0.80. The bar graphs showed the Modeling approach score lies most of the time between 2 and 3 in weighted average across the four MEAs on the five dimensions of TRU Math rubric.

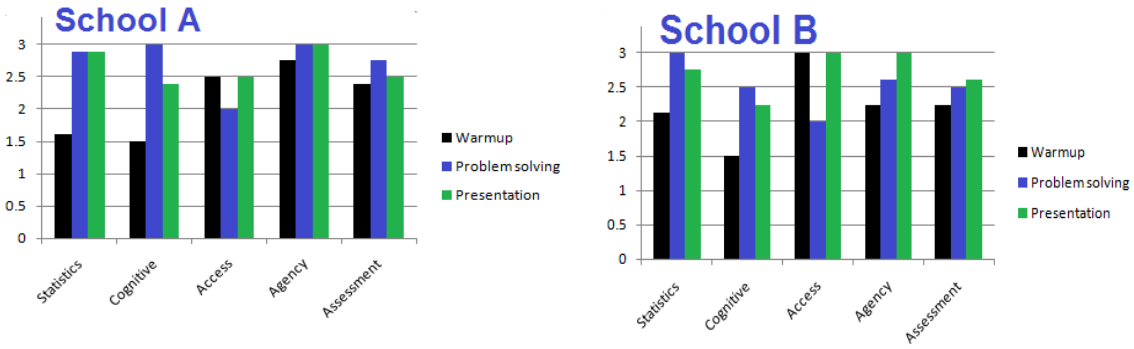


Fig. 2 Results of observation in the two schools using TRU Math rubric

3.2 The Case of Students' Models for Tourist MEA

Historical & Natural Tourist Attractions' is given as a reading homework to students and followed by readiness or warm up questions for discussion such as: What does it tells you about the temperature in Addis when it says in an average the temperature is 61 degrees Fahrenheit? What do you think the temperature in Addis Ababa might be for 6 different days in the year? Why do you make these choices? Next students were given a data table on 'the climate data for the four tourist attraction sites' and asked to write a report for the tourist describing and comparing the climate data for the four tourist attraction sites telling them what type of clothes they should wear and what type of food(drinks) they should take or have. Therefore, below are the responses of students' model at different levels.

a) Students' Models at Level 1: Two teams of students were at this level. For example, a team of students gave general information on what clothes and shoes to wear, what food to eat and what drinks to drink, but they barely used data in their report to meet the client needs. The report presented by the team of the students' model on Tourist MEA at Level 1 was given below.

Dear Tourist, it is advisable that a tourist visit a country in September because the weather condition is conducive. When the tourist wants to visit a country, he should not bring clothes for cold weather, that is, he/she should bring light clothes. The shoes should be Sandals as there is no snow in the tourist sites. The tourist needs to bring an umbrella in case it rains. Besides, the tourist should bring fast foods and cold drinks. M.D = 28+23+35+23/4 =23 M.D= /-5/+/-7/+/-5/ +/0/ divided by 4 equals 7 and M.D= 1.25

b) Students' Models at Level 2: Eight teams of students were at level 2. They used only one model, which was range to describe the average annual temperature of two tourist attraction sites out of the four sites. They used partial data of the provided data and they tried to give information on two tourist attractions sites. The reports needed further refinements using more variables and data to furnish the tourist with good information for the four tourist sites. The report presented by the team of the students' model on Tourist MEA at Level 2 was given below.

Dear Tourist, Welcome to the attractive tourist sites of Ethiopia! We would like you to introduce two historic tourist attraction sites in Ethiopia. The two sites are known as Harar and Aksum. Harer is a city protected by stone wall and it is recognized by UNESCO. The people of Harer are well known for their hospitality and love. Both Christian and Muslims have lived in Harmony for centuries. Harer is found at an altitude of 55m above sea level. The range of average temperature and rain days for a year in Harer is 5 degree centigrade and 9 respectively. Axum is a city well known for its obelisks for example one obelisk has a height of 33 meters. Aksum is found at an altitude of 2355 m which is at higher altitude than Harar. The range of average temperature and rain days for a year in Harer is 3 degree centigrade and 9 respectively. Dear tourist, Harar is hotter than Axum. You need to visit both places, because both of them are historical places and their social life and culture are interesting. Good Luck!

c) Students' Models at Level 3: Eight teams of students were at level 3 on Tourist MEA. For example, a team of students at this level used two models (range and bar graphs) to give information to the tourists using the provided data. They tried to present the data using bar graphs and range on average annual temperature on the two-tourist attraction sites as shown in Figure 3. The report and bar chart presented by the team of the students' model on Tourist MEA at Level 3 were given below.

Dear Tourist, We would like to give you reliable information about health requirement, customs, transport, time, currency, topography, etc. We would like to introduce two tourist attraction sites, which are known as Axum and Lalibla. The range of the annual average temperature of Axum is 30c and the range of the annual temperature of Lalibla is 150c. Therefore, the Lalibla temperature is hotter than the Axum temperature. Therefore, if you go to Lalibla you must wear white or light clothes, since it will be hot there. You can see and compare the temperature difference using the pair of bar graphs as shown for the two sites. Come and visit us we will *give you further information!*

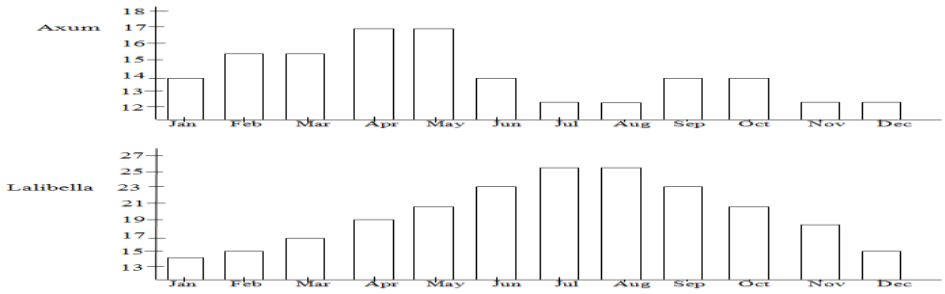


Fig.3 Team of students' Model on Tourist MEA at Level 3.

d) Students' Models at Level 4: One team of students was at level four. Similar to team of students at level 3, the team had used range and bar graphs. But the team of students gave description on the rainfall amount of the four places in addition to using the average annual temperature. The report and bar chart as shown in Figure 4 presented by the team of the students' model on Tourist MEA at Level 4 were given below.

Things to do for Tourist! There are many things that we do for tourists; they may come from a country far from Ethiopia. Thus, they may not know our local languages that we have to translate the local language for them. We can also help them by carrying their goods, food, clothes and other necessary materials. We can also use range to show the tourist sites climate variations to give information for tourists.

- Axum- has low range because 18 – 15 = 30c and rain-high = 11 mm
- Lalibela-has high variation because 28 – 13 = 150c and rain-low = 1 mm
- Gonder-has high variation because 35 – 23 = 120c and rain-low = 1 mm
- Harar-low variation because 28 – 23 = 50c and rain high = 9 mm

Dear tourists, welcome to the attractive sites of Ethiopia. Ethiopia is a country abundant with varied tourist sites, which are attractive, and you will have memories of these sites in your mind. We will say, welcome again! Now I am going to tell you about

Ethiopian tourist sites. Ethiopia has many innumerable tourist sites that it is difficult to count in short period of time. Among the well-known sites by tourism sector, we take today Axum, Lalibla, Gonder and Harar. We can see different amazing things at these places. Our dear tourists, if you want to come to Axum, you have to wear sweater, normal trousers and you need to have tea because there will be rain days. Again, if you want to come to Lalibla, you have to wear t-shirt and need to have cold water and you have to have vegetable food because this place is very hot. As we notice from the graphs, most months have high variation by temperature. At the end, please try to come to visit Ethiopian tourism.

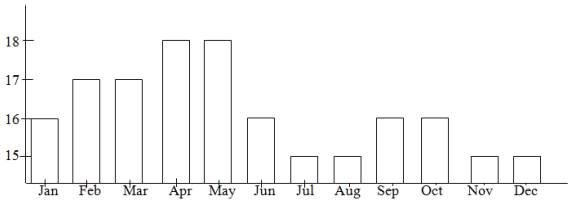


Fig. 4 Team of students' model on Tourist MEA at Level 4.

e) Students' Models at Level 5: One team of students was at level five. The team's report assumed to be sharable and reusable as the students used all the variables from the provided data and different models to describe the four tourist sites. They interpreted the data correctly within cultural contexts of the tourist sites like wearing style, social life of the people. They presented the information as if it was given in FM radio transmission. The report presented by the team of the students' model on Tourist MEA at Level 5 was given below.

This is Ethiopian FM RADIO! Dear tourists, first welcome to Ethiopia! We are happy to announce you that you will be happy for visiting Ethiopia, the country, which has several historic, cultural, and wildlife tourist attraction sites. Among the cities for tourist attractions, I will give you important information on Harer and Gonder. And Helen will give you information about the attractive tourist sites of Lalibla and Axum. Please be with us! Based on data, Harer is located at an altitude of 55m above sea levels. It is known for its people kindness and the city is called a 'love country'. Thus, this culture is closer to Brazilian culture and that many Brazilian come to visit Harar. The range of the average temperature for Harar for a year is 5 degree centigrade with medium temperature. Thus, we need to wear light clothes like traditional Harar clothes called 'dereya'. When we look at the rainfall amount, it has a standard deviation of $\sqrt{6.24}$. When we go to Gonder, it is located at an altitude of 380m above sea levels and it is a city that we found several historic and cultural places to visit. The range of the average temperature for Gonder is 12 degree centigrade for a year with hot temperature. The standard deviation of the rainfall amount of Gonder for the year is $\sqrt{2.39}$. Now, Helen will present you information on other two cities.

Thank you Hanan! I will present you information on the great Ethiopian cultural Heritage placed called Aksum and Lalibla. Axum is a place where it attracts many

tourists in the world and located at an altitude of 2355m. The range of average temperature for Axum is 3 degree centigrade, which means it is not a hot place. The standard deviation of the rainfall amount is $\sqrt{14.85}$ and you can wear whatever cloths you like. When we see Lalibla, it has range of average temperature of 15 degree centigrade. The people who lived in Lalibla often wear white clothes to reflect the sun light radiation. You could also stay there wearing light clothes suitable for the weather condition. Lalibla is located at an altitude of 74 m from sea level and the standard deviation of the rainfall amount is $\sqrt{1.34}$. Thank you for staying with us! We will meet in another program.

Using Quality Assurance Guide for the four MEAs Table 5 indicated that the percentage of number of teams of students' solution at level 1, 2, 3 and 4 were 10%, 38.8%, 45% and 5% respectively. Only one team of students' solution was considered at level 5 across the four MEAs. The majority of teams of students were at level 2 and 3.

Table 4. Number of teams' at the five performance levels for the four MEAs.

Performance Level	MEA-1 f (%)	MEA-2 f (%)	MEA-3 f (%)	MEA-4 f (%)
Level one: Requires Redirection	3 (15%)	2 (10%)	1 (5%)	2 (10%)
Level two: Requires major revision	7 (35%)	8 (40%)	8 (40%)	8 (40%)
Level three: Requires revision	9 (45%)	9 (45%)	10(50%)	8 (40%)
Level four: Useful for the specific data	1 (5%)	1 (5%)	1 (5%)	1 (5%)
Level five: Shareable and reusable	0 (0%)	0 (0%)	0 (0%)	1 (5%)

3.3. Students' Project

Teams of students selected the investigative themes by their own. They chose the themes and go through data modeling process to solve social-cultural problems on issues of health, education, culture, economic, gender inequities. Some of the themes focused on giving an awareness program to students to take some preventive cares related to health issues like dental care, body mass index, sleep, and first aid. Students had investigative themes such as learning motivation, attendance, girls' education, achievements, study and entertainment time. Teams of students also did projects on economic and transport problems, which could solve existing problems in the community with social justice agenda. Some of the themes dealt with traffic accidents and transportation problems in the town. One of the students on traffic project put her concern in the interview that she was responsible for creating awareness about traffic accidents for students with a sense of social justice.

Teams of students wrote a project report within 3 to 18 pages. Every team of students prepared a colorful poster displaying various graphs and use descriptive statistics to present reports on their projects. Two case studies of the final reports will be discussed on the next section.

The teams were trying to present their project using different styles. Three teams used dramas to present their projects. Others presented news, poems and comedy to present their reports attractively. One team of students who worked on cultural clothes had a fashion show. Three teams of students included interviews on their presentations, for example, on BMI project the students interviewed one of their team members as medical doctor to give advice on how to keep normal BMI.

Case #1 Selam's team project was about students' scores in the first semester and her team wrote in their final project report that the vision of their investigation was to see students' scores to be much better in the second semester than the previous semester. The team stated that their objective was to help students achieve high scores by initiating students to study hard. Selam said the following in the interview on how they selected the project:

When we select the theme of our project, we noticed that students' scores in the first semester are very low and we discussed how to improve the scores. When we asked some students they said, 'We wish there was no first semester and we wish if the first semester pass over unknowingly….' In our section, a female student whom we do not know stood first. We are doing this project to initiate students to score better in the second semester than the first semester (Selam: 29/4/2014).

The method they used to collect data on this project was oral survey by asking students from class to class. The team asked six statistical questions, which helped them to collect continuous and categorical data. Their data analysis used all measure of dispersion. They used visual displays such as frequency distribution tables, dot plot, bar graph, pie chart and histogram. The graphs were appropriately labeled on the axis and contain titles as shown in Figure 5 and the calculations on measure of center and dispersion of the data were accurate with correct interpretations. Selam's team wrote the following result in their report from the oral survey of 30 students:

Even if, one of the reasons for low students score was not studying hard, there are other reasons for students' low scores like work burden on female students at home, the living conditions of students, and lack of students' hope in their education. As a result, students lack any interest to learn something. In general, students, who had a lot of work to do at home, are forced not to have study time; since there is no one to help their family. Especially, this problem is common for rural female students. For urban students, the major problem is lack of interest and hope in their education, because they see college and university students at home without getting any jobs after graduation.

After pointing some of remedies for the above problems, the team started to summarize the data on last semester average using dot plot and wrote:

As the saying goes, 'If you do not sow the seed well, you can't get the harvest.' Students result for few are good and for the majority it is unsatisfactory. The range for 30 students' data score is 65 with mean score 65.2 and students' data scores standard deviation is $\sqrt{342.692}$. The standard deviation shows that there is a big variation among students' scores in the last semester.

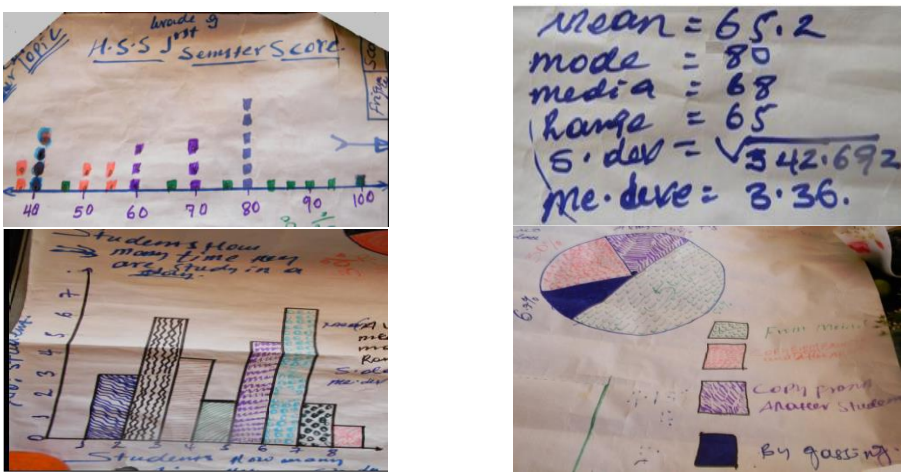


Fig. 5 Students' Scores Project Visual Displays of Data.

The other main concern of the project was the problem of copying during examinations. They reported using pie chart that 50% of the students did independently by themselves, 30% copy from exercise books and notes, 13.3% copy from other students and 6.7% did just by guessing while taking tests and examinations. Overall, all components of the project report were clearly present and of excellent quality. Among the project phases, Selam had expressed her views that data organization and analysis phase was difficult.

Case #2 Chirenet and Degenet were members of a team who did a project on Body Mass Index (BMI). Chirenet responded in the interview that the team chose the project theme for the following reason:

First, we could not estimate whether a student is normal, overweight or underweight without any measurement looking at students' body. For example looking at a student's body, we cannot say he is overweight since his weight could be distributed over his height. If he is tall and if we divide the weight by the square of his height, he may have normal BMI. Most people do not know their height, weight and BMI; that, they will be exposed for many health problems. Thus, we think the project is important for us and for many other students (Chirenet: 28/04/2014).

The team found that 50% of the students were underweight and the team worked on the project with a social agency aim to alleviate the problems giving an awareness program: If we do not weigh their weight and measure their height, then we could not know the BMI. Since we know how to use statistics, we are able to give an awareness program for others and for ourselves on how to keep our health (Chirenet: 28/04/2014).

Chirenet and Degenet team made a pie chart, dot plot, histogram and a bar graph. The team used dot plots to show the age of students, bar graph to show the sex of students and a histogram to show the distribution of students' weight. They used also measure of center and variation accurately with correct interpretation of the data. But, they had

not used standard deviation as measure of variation. Chirenet and Degenet expressed their views that among the project phases, data collection phase was difficult. In their final presentation, Degenet made an interview with Chirenet as if he was a doctor to advice students on the need to check one's BMI.

4 DISCUSSION

Students' in a team worked on multi data sets and on multi variables by reading articles and by writing reports and letters using statistics towards enhancing their critical understanding for social justice. Learning statistics is not only computing, but also involves describing and interpreting situations statistically (Lesh, 2000). The finding of the study suggests students can draw conclusion informally from data in a context on MEAs as contents of students' reports showed. The multiplicity of students' reports on MEAs showed students can develop authorships of ideas than relaying simply on text books and teachers.

The finding suggested students found the MEAs relevant to their life and they were 'hard fun' activities. Students were able to think 'outside of the subject box' in multidisciplinary areas. Statistics is at an intersection of many subjects, since all subjects will use some data to work with concepts. According to (Freire,1970), it is better if students select the investigative themes by themselves than investigative themes assigned by a teacher. Students had developed their critical understanding of descriptive statistics using statistics as critical tool towards solving the socio-cultural problems. Students were working on themes that arose from educational to economic to social life and culture problems. Students were presenting awareness program on avoiding copying during examination, keeping dental care and body weight regularly, resolving problems on gender issues and the like.

Students' were able to develop their critical productive disposition towards statistics. Students' had used different entertainment and fun using statistics as a critical tool to give an awareness program on their project themes. Students had used drama, live interview, fashion show, poems that could add value to their productive dispositions towards statistics as a tool that could be used in their everyday life to solve their own and society's problems. Students could enhance the statistical thinking, which emphasis-making conclusion based on data in a context. More importantly, the finding of the students' project showed that students at their youth age could pose and solve significant problems as social agents.

It is morally important to teach statistics using Modeling Approach to enhance students' critical understanding of descriptive statistics. It is good that people live in the world with sympathetic understanding, that is, 'survival with dignity'. The youth can be misinformed at the age of information if they did not discern the good from the bad. Even though the world is not a safe place to live for everyone in the world nowadays, it is valuable to work against dehumanization using data based evidences. Statistics may not be considered simply as useful, but also as a tool to help solve social problem. Students need to learn how to live together working in a team using statistics

as a critical tool by solving real social modeling problems in class and through project works. The findings of this study suggest students could enhance their critical understanding using Modeling Approach, since it offers a chance to work on real social problems to transform the life of disadvantaged society.

Students had been doing the projects having some kind of team sprits and the finding of the study suggest they likely develop abilities to work in teams. In the 21st century, working in multi-disciplinary areas with a team is one of the abilities students need to develop (English, 2013b), (Lesh, 2000). Students were working in teams with interdependency and helped each other towards finishing their project with preservation. They developed team sprite and learning to live together working on the projects.

There is a myth that students had fixed abilities in doing mathematics. Pedagogy with social agency could promote students empowerment beyond fixed abilities with open-ended projects. Defenders claim that if teachers teach statistics using Modeling Approach, students may not get the basic building blocks of knowledge. They assume that students need to learn first the basics, then apply what they learned later on in another statistics lessons or in application problems. Of course students need to learn a healthy dose of basic concepts and a focus only on problem solving process without skills will deter their procedural fluency; however it is possible to use Modeling Approach to enhance basic skills as well as the cognitive thinking and reasoning at the same time, since Modeling Approach enhance students' basic knowledge while they solve modeling problems. A decade of mathematics education research showed that students could enhance high cognitive thinking on 'rich tasks' without compromising the basic skills and knowledge (Schoenfeld,2004, p.256).

Defenders also may claim that modeling problems are challenging that students could not attempt to solve the problems. Neither a teacher wants to teach statistics by giving students challenging problems, which frustrate them to attempt, nor does he/she want to teach students by spoon-feeding. However, teachers need to strike a balance to teach students with some sense of challenges so that students get a chance to enhance their cognitive thinking. Even a child from the early age naturally requires some challenge; the challenge for six-month baby may be walking.

Teachers need not avoid modeling problems in the pretext of students are young that they do not need to work on modeling problems for the reason that they are challenging. But, learning theory supports that students learn well through perturbations, since human minds disallow the disequilibrium created by the challenge. Through scaffolding, students could solve the modeling problems through iterative cycles of assimilation and accommodation. The findings of the study suggest, students could undergo data modeling processes; even if, they were not experts at modeling. Social interactions in teams of students were the cause of accommodations as observed in MEAs lessons.

5 CONCLUSIONS

Traditionally statistics have been taught using a formal approach and teachers might continue with the usual practice. However, following traditions may have negative side to enhance the kinds of understanding students' need in the 21st century in an age of information. In fact, to reveal a particular practice as having a status of a tradition could not shed light on whether it is a good one or a bad one. Statistics is at the intersection of many disciplines that stakeholders need to take part for enhancing students' critical understanding for the benefit of all not just for mathematicians or mathematics educator. If Modeling Approach enhances students' critical understanding of descriptive statistics within the interest of all stakeholders, then it needs to be considered seriously to incorporate modeling problems in the statistics curriculum, instruction and assessment in an education system. Students at their youth age need to solve relevant non-routine problem solving tasks to enhance their critical understanding, which could enable them to cope up with the nature of problems in 21st century. The study revealed that students doing modeling activities and projects by reading and writing the world with statistics could enhance their critical understanding towards social justice.

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DIJBAR
www.daagu.org
Volume-1 Issue-1

A Critical Appraisal of Amaranths and Chenopodium Weeds for Their Harmful and Beneficial Aspects in Context to Food Security in Pastoral Area

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ABSTRACT

Amaranths and Chenopodium species are among the worst weeds in the world. They are annuals competing with many economic crops including cereals and vegetables in different parts of the world including Ethiopia and cause great yield losses. Lack of knowledge about these pseudo-cereal weeds has created an atmosphere of uncertainty among the farmers particularly in pastoral area like Afar. On the other hand, food insecurity is a reality for hundreds of millions of people around the world. As a consequence of globalization and industrialization of agriculture, global food security has become increasingly dependent on only a handful of fertilization and high energy demanding plant species. These two crops, rich in high quality protein content with various essential vitamins and minerals may be an ideal alternative. In Ethiopia, food insecurity is highly prevalent in moisture deficit highland and in the lowland pastoral areas. Even in years of adequate rainfall and good harvest, the people, particularly in lowland agro-pastoral areas, remain food insecure and in need of food assistance. The mentioned facts stimulate the retrieving of alternative crops into the production. Thus, the present paper is a more comprehensive appraisal of these weeds that attempts to provide information on eco-physiology and economic significance of Amaranths and Chenopdium into a new perspective with a special focus on beneficial and harmful impacts on livestock and human.

Keywords: Amaranth, Crop diversification, Food insecurity, Nutritional value, Quinoa.

Citation: Mohammed Gufran Khan, M. Abate, Endris S. and Abebe Chaka (2019). A Critical Appraisal of Amaranths and Chenopodium Weeds for Their Harmful and Beneficial Aspects in Context to Food Security in Pastoral Area. Daagu International Journal of Basic & Applied Research-DIJBAR. Volume1, Issue-1, pp (58-69)

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Received: 23/04/2019

Accepted: 30/05/2019

Published: 10/06/2019

OPEN ACCESS

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1. INTRODUCTION

Amaranths and Chenopodium(pigweed) species are among the worst weeds in the world. They are annuals competing with many economic crops including cereals and vegetable in different parts of the world and cause great yield losses (Bressani, 1989, 2003 ; Berghofer and Schoenlechner, 2002; Brainard *etal*., 2007; Collins *etal*., 2008). Amaranths (*Amaranthus* spp.) and quinoa (*Chenopodium* spp.) commonly categorized as pigweeds are pseudo-cereal that have been widely grown by the Aztecs, Incas and Mayas in Latin America since pre-Columbian times for millennia. These grains are endemic to Andes of South America. Cultivation areas extend from Southern Colombia to Northern Chile and Argentina. Currently, Peru and Bolivia are the two largest producers and exporters of quinoa in the world.

Amaranths (*Amaarnths spp*) and Quinoa (*Chenopodium*) are treated as grains although they have broad leaves, unlike the true grains and corn, which are grasses. Their leaves are among the most nutritious of vegetable greens but it is their grain that put them under a category of crop. Protein content of these two alternative food crops has essential amino acid balance that is near the ideal level. Both of these plant species come closer to meet the genuine protein requirements of the human body than either cow's milk or soybeans. They are high in the amino acid lysine, which is lacking in most cereals such as wheat, sorghum, maize and barley.

On the other hand, food insecurity is a reality for hundreds of millions of people around the world (Webb *et al.*, 2006). About 17 million people in East Africa are highly or extremely food insecure and are in need of emergency humanitarian assistance (FEWS NET, 2010). In Ethiopia food insecurity is highly prevalent in moisture deficit highland and in the lowland pastoral areas. Even in years of adequate rainfall and good harvest, the people, particularly in lowland agro-pastoral areas, remain food insecure and in need of food assistance (Mathewos, 1996). The mentioned facts stimulate the retrieving of alternative crops into the production. In spite of all these circumstances, relevant information on these pigweeds viz., amaranths and quinoa regarding their economic use as food and feed are meager and rather contradictory which create a sense of uncertainty among farmers and affected community.

Thus, the present communication is a more comprehensive review that attempts to bring eco-physiology, cultivation and economic significance of amaranths and quinoa into a new perspective, with a special focus on beneficial and harmful impacts on livestock and human.

2. ECO-PHYSIOLOGY

Pigweeds and Sugar red root are easy to recognize, yet correct identification of pigweed species can be tricky. Two or more pigweed species often occur together in the same field. Significant variation can occur within a species, and inter specific hybrids occasionally occur (Weaver 1980 .Sellers *et al*., 2003). These species may

grow in wheat or other crop as annual weed. Most pigweeds grow into large, erect-to-bushy plants, 2–7 feet in height, with simple, petiolate (stalked) leaves arranged alternately (singly) on stem. Leaf blades are generally oval-to-diamond shaped, and 2–6 inches long. Prostrate pigweed forms a low, spreading mat, with smaller (about one inch) leaves that are distinctly notched at the tip. There are so many similarities between quinoa (keen' wah) and amaranth that it seems appropriate to describe them together. Quinoa, however, is a cool weather crop and amaranth is a warm weather one.

Physiologically, quinoa or *Chenopodium* is predominantly halophytic plant belonging to family Chenopodiaceae growing in saline and xeric conditions. It grows as annual herb sometime perennial. On the other hand, Amaranths is a non-halophytic annual herbaceous plant belongs to family Amarathaceae. Chenopodiaceae is closely allied to Amaranthaceae from which it differs in not possessing membranous perianth and connate stamens. *A. tuberculatus* (Pratt and Clark, 2001), Newly emerging pigweed seedlings open a pair of long, narrow cotyledons, about 0.5 inch long by 0.1 inch wide, followed by the first true leaves, which are broader in outline. Plants form moderately deep, branching taproots, and may show a distinct reddish coloration on roots, lower stems, and undersides of leaves

3. BENEFICIAL ASPECTS

3.1 As grain and feed

Although the origin of this grain is old, interest in amaranth has arisen recently because of its useful nutritional qualities. The small seeds contain considerable levels of high-quality protein (rich in lysine) and low levels of saturated fatty acids in their oil moiety, thus winning room on the health food store shelves. The seeds have a protein content of about 16 percent, more than wheat, rice or maize and a digestibility score much higher than soy, milk and wheat.

The grain has some protein (12 % to 17 %) and is high in lysine, an amino acid that is low in other grain crops. The grain is high in fiber and low in saturated fats, factors which contribute to its use by the health food market. It is an exceptionally rich source of calcium, iron and vitamin C, a very rich source of potassium, vitamin A and riboflavin, a rich source of niacin and an above-average source of protein. Grain amaranth has been used for food by humans in a number of ways. The ground grain is used in breads, noodles, pancakes, cereals, granola, cookies and other flour-based products. The grain can be popped like popcorn or flaked like oat meal. More than 40 products containing amaranth are currently on the market. Little is known about the production and utilization of amaranth as forage. The leaves stem and head are reportedly high in protein (15 to 24 % on a dry-matter basis). A relative of grain amaranth, redroot pigweed, has been shown to have 24 % crude protein and 79 % in vitro digestible dry matter. Vegetable amaranths, which are closely related, produce 30 to 60 t/ha of silage (80 % moisture). In areas where corn silage yields are low owing to moisture limitations, grain amaranth may become a suitable silage alternative after further research. There are many species of amaranth in cultivation.

Some types of amaranth are grown for their edible seeds, while others are cultivated for their edible greens. Amaranth is widely cultivated in West Africa for its edible greens, particularly in Sierra Leone. The plant is a fast-growing annual which loves high temperatures, to attain its maximum growth of 5 to 6 feet. *Amaranthus tricolor* is the most commonly grown species in Sierra Leone, preferred for its ability to produce high-quality, tasty green/ The grain is processed in various ways for consumption, of which the expanded grain form is perhaps the most popular. Other processes include cooking in water, extruding, toasting, incorporating it into flakes (Bressani *etal.,* 1993; Saunders and Becker, 1984) or pastas and baking into bread. In Mexico, *A. cruentus* cultivars are used to manufacture cookies called "Alegria," in which amaranth is used in the form of popcorn (Irving *etal.,* 1981). In Asia, the Indian diet finds in amaranth grain a culinary acceptable high protein, high fiber, alternative to wheat, easy to incorporate into the traditional cuisine (Dixit *etal*., 2011). Despite being gluten-free and having formidable nutritional properties, amaranth and quinoa, are not exploited by the food industry (Izquierdo and Roca, 1998). Amaranth and quinoa possess high quality protein (10-15%, albumin and globulin), considerably amount of fibre (8-10%) and bioactive compounds such as phenoliccompounds, tocopherols and folate (Ranhotra *et al*., 1993; Lopez etal., 1994; Repo-Carrasco-Valencia, 2011b). Repo-Carrasco-Valencia et al. (1993) reported that quinoa var. Amarilla de Marangani had no limiting amino acids. Ranhotra *etal*.(1993) observed that protein quality in quinoa (protein digestibility, protein efficiency ratio and nitrogen balance) was equivalent to that of milk protein casein.

3.2 As Vegetable

Amaranths and quinoa have been rated considerably higher in minerals, such as calcium, iron, phosphorous (Santos *etal.,* 1997) and caretonoids (Bressani, 2003) than most vegetables. However, these vegetable species received less research attention than grain amaranths. Their use as salad in place of lettuce spinach is quite common in many places. Moreover, pharmacological properties of different amaranth species have also been investigated. It was determined that *Amaranth paniculatus* and *Amaranth cruentus* are good sources of flavanoids, especially for rutin, which are mostly produced in the stage of blossoming. Usage of amaranth as livestock feed indicated relatively high protein qualities (Alegbejo 2013).

3.3 As Medicines and Treatments of Diseases

In the last few years, the properties of amaranth in cholesterol reduction, as an anti-oxidant, anticancer, anti-allergic, and antihypertensive agent; and as a food for patients with celiac disease and immune-deficiencies, have been assessed in clinical studies.

3.4 Hypocholesterolemic Activity

Amaranth grain has a hypocholesterolaemic potential (Berger *et al*., 2003; Plate and Arêas, 2002 Chaturvedi *2000*). Several hypotheses have been proposed to explain the treatment ability of Amaranths, Chenopodium and related weeds which is the modulation of the serum cholesterol levels. One of such hypotheses cited the content of unsaturated fatty acids. Concurrently, the amount of total and soluble fiber has also

been mentioned (Danz and Lupton 1992; Plate and Arˆeas 2002; Mendonca *etal*., 2009), and possibly that the amino acid profile of its protein (Berger *etal*., 2003) may as well be involved in the mechanism.

3.5 Effect on Hypertension

The renin–angiotensin system is a biochemical system that helps control blood pressure. Amaranth grains may be a potential source of several bioactive peptides with relevant actions on cancer and hypertension.

4. HARMFUL ASPECTS

Besides significant beneficial effects, amaranths and Chenopodium spp. have also serious impacts on agricultural production. It is estimated that in general, these weeds cause 5% loss in agricultural production in most of the developed countries, 10% loss in less developed countries and 25% loss in least developed countries. In Ethiopia also, yield losses due to weeds are more than those from pest and diseases. Yield losses due to weeds vary with the crops. Every crop is exposed to severe competition from weeds. Most of these weeds are self-sown and they provide competition caused by their faster rate of growth in the initial stages of crop growth. In some crops, the yields are reduced by

Weeds reduce the quality of marketable agricultural produce Weeds not only reduce yield but also interfere with agricultural operations. Weeds make mechanical sowing a difficult process and render harvesting difficult, leading to increased expenditure on labor, equipment and chemicals for their removal. In aquatic environment, weeds block the flow of water in canals, water transport system and drainage system, rendering navigation difficult. The dense growth of aquatic weeds pollutes water by deoxygenating it and killing the fishes. Weeds are also a nuisance and a fire hazard along railway lines, roads, right-of-ways, airports, forests and industrial sites.

Many species of Amaranth and quinoa like Palmer amaranth may be consistently high in nitrate and potentially toxic to cattle, so it is important for producers to know these species before using it as a forage crop for livestock. In addition to poisonous plants, some new publication provide information on plants that can cause metabolic disorders in livestock.

5. CULTIVATION

5.1 Soil preference

Quinoa and amaranth grow well in a variety of soil types. They are responsive to nitrogen and phosphorous. Plants grown in average garden soil will be 4-feet to 6-feet tall, while those grown in rich soil or compost may reach over 8 feet. Optimum soil is a well-drained loam but both plants will do well in all but poorly aerated clay soils (Organic Seeds, 2016).

5.2 Varieties

Named varieties of amaranth and quinoa are increasingly available from seed companies. Most North Americans would be hard-pressed to describe the subtle differences in flavor between cultivars. Black-seeded varieties of amaranth stay quite

gritty when cooked, so it is best to use these varieties just for their leaves. Amaranth is a heat-tolerant green that is often called vegetable amaranth to distinguish it from the similarly named but different landscaping amaranth. The smaller varieties planted as decoration will not produce any usable seed, but can still be eaten as salad greens. Unlike most salad greens, this one thrives in hot weather, so if we grow amaranth, Malabar spinach, orach, or purslane for that matter- we can keep the salads coming all year long. Amaranth delivers salad greens when lettuce and spinach have long since bolted. Besides to tasting somewhat spinach like, amaranth is healthful: lots of protein, vitamins, minerals, and dietary fiber. In addition to growing for salad greens, it is grown for its grain (Robinson, 1989).

5.3 Planting and Sowing

Quinoa, however, is a cool weather crop and amaranth is a warm weather one. Quinoa grows best where maximum temperatures do not exceed 32°C and nighttime temperatures are cool. For most southern Canadian and northern U.S. sites, the best time to plant quinoa is late April to late May. When soil temperatures are around 15°C seedlings emerge within three to four days. However, when quinoa seeds are planted in soil with night-time temperatures much above that, quinoa, like spinach, may not germinate. In this instance, it's best to refrigerate seeds before planting (Organic Seed, 2016).Amaranth is a warm season crop that requires full sun. Best germination occurs when soil temperatures range from 24-32°C. The small seeds of amaranth and quinoa will germinate more successfully with a finely prepared surface and adequate moisture. Seeds should be sown no more than one-quarter inch deep in rows 45-60 cm apart or wide enough to accommodate a rototiller between the rows without damaging the plants. Planting can be done by hand or with a row seeder. Plants should eventually be thinned to 15-45 cm apart. One gram of seed will sow 15 m of row.

5.4 Management

Quinoa resembles lamb's-quarters and amaranth resembles red-rooted pigweed, especially in the early stages of growth, so it is best to sow seed in rows to make weeding less confusing. Sowing amaranth cultivars with purple leaves also simplifies weeding. Since seed is small, we can avoid considerable thinning by mixing it with sand or radish seed before sowing, as is sometimes done with carrots. Amaranth and quinoa are low-maintenance crops but weeds, especially at the beginning, should be discouraged by cultivation or mulching.

Quinoa and amaranth are very easy to grow. They are fairly maintenance free, but their slow initial growth leaves them susceptible to competition among weeds until they are established. Flowers are produced on long straight stems, are long lasting and will bloom from mid-summer until the first hard frost (Organic Seed, 2016).They appear slow growing at first but both are extremely drought tolerant and do well on a total of 25 (cm) of long. As the plants reach about one foot in height, they start to grow very rapidly, the canopy closes in, weeds are shaded out and less moisture is lost through evaporation.

The major pests of Amaranth and Quinoa are i. *Tarnished plant bug* - congregate around the growing seed heads and by sucking the fluid out, they can stunt the seed production. ii. *Amaranth weevil*- The weevils are a 2-stage threat with the larvae chewing on the roots and the adults going after the leaves. However, disease is seldom a problem in both of these crops.

5.5 Harvesting

Quinoa is ready to harvest when the leaves have fallen, leaving just the dried seed-heads. Seeds can be easily stripped upwards off the stalk with a gloved hand. Quinoa resists light frosts especially if the soil is dry. So long as maturing seed passes the green stage, frost will cause little damage and harvesting can be done a day or two later. Extreme hot weather and warm nights inhibit fruit set. It is important to watch the weather when quinoa is ready to be harvested: if rained on, the dry seed can germinate. If the heads are not completely dry, harvest them when you can barely indent the seeds with the thumbnail (Scoop, 2017).

In Amaranth, pick individual leaves as needed for greens. Younger greens are great for salad; older greens are better cooked as a substitute for spinach. Seed will often ripen many weeks before the first hard frost, usually after about three months from planting time. The best way to determine if the seed is able to be harvested, to gently but briskly shake or rub the flower heads between your hands to see if the seeds fall readily. Numerous small and appreciative birds may give hints as to when to start doing this. The best time to harvest the amaranth grain is on a dry day 3 to 7 days after a hard frost. After harvesting it is important to further dry the crop to ensure it won't grow mold in storage (Scoop, 2017). It can be left on trays in the hot sun, or placed near an indoor heat source. Stir occasionally until it is as dry as possible. Store seeds in an air-tight container in a cool dry place. Amaranth grain is fairly high in fat, and can go rancid eventually. The best way to store it is in the fridge, in a tightly sealed container. The grain should last up to 6 months this way.

5.6 Threshing

Unlike beans or true grains, quinoa and amaranth have no hulls to remove. However, quinoa is covered with a bitter substance called saponin, which birds and deer won't touch. Because of this coating, quinoa requires thorough rinsing before cooking. One method is to put the grain in a blender with cool water at lowest speed, changing the water about five times until it is no longer soapy. We can also get away with less or no rinsing by mixing quinoa with other grains or pulses, rendering the saponin hardly noticeable. Amaranth has no saponin and no hulls, so can be cooked without additional preparation (Scoop, 2017).

5.7 Yield

Normal commercial yields for amaranth and quinoa are 500-900 kg per acre. Combiner machines are still being adapted to the lightness of the seed, and full harvest potential is yet to be realized. Much higher results are obtained from labor-intensive harvesting: yields of over 3,000 kg per acre have been reported from Central and South America (Scoop, 2017).

6. NUTRITION

Quinoa and amaranth have exciting possibilities for the home gardener looking for hardy, easy to grow, high-protein foods. They have higher food quality than our common grains such as wheat and oats, and they don't have hulls that need to be removed by machinery prior to cooking. A number of reports suggested that the difficulties in cultivating and preparing these two grains are relatively minor and that the pleasures obtained in growing and eating them are definitely major. With a protein content of about 16 percent, amaranth seed compares well with the conventional varieties of wheat (13 %), rice (8 %), maize (9 %), and other widely consumed cereals. Amaranth seed also contains protein of unusual quality, mainly because of its high lysine content. Cereals are considered "unbalanced" in terms of amino acid composition because generally they lack sufficient amounts of lysine for optimum health (Berghofer and Schoenlechner, 2002). Amaranth protein, however, has nearly twice the lysine content of wheat protein, three times that of maize, and in fact as much as is found in milk-the standard of nutritional excellence. It is, therefore, a nutritional complement to conventional cereals (Berghofer and Schoenlechner, 2002). Amaranth protein itself is low in leucine, but this amino acid is found in excess in conventional plant protein sources. Amaranth grain, however, contains little functional gluten, so that it must be blended with wheat flour to make yeast-leavened baked goods "rise." When heated, the tiny amaranth grains pop and taste like a nutty flavored popcorn.

Table 1. Nutritional Contents Per 100 gm of Grain

Nutrients	Amount	Vitamins	Proportion	Minerals	Proportion
Energy	371 kcal	Vitamin B1	10%	Calcium	16%
Carbohydrates	65.25 g	Vitamin B2	17%	Iron	59%
Starch	57.27 g	Vitamin B3	6%	Magnesium	70%
Sugars	1.69 g	Vitamin B5	29%	Manganese	159%
Dietary fiber	6.7 g	Vitamin B6	45%	Phosphorus	80%
Fat	7.02 g	Vitamin B9	21%	Potassium	11%
Protein	13.56 g	Vitamin C	5%	Zinc	30%

Quinoa and amaranth both contain about 16 percent protein, vitamin E and B, calcium, iron and phosphorous. They are easy to digest and have wonderful flavor. Their simple distinctive taste gives them great versatility for cooking purposes. They can be substituted for other grains in many recipes, though they are much more filling. Because they are not true cereal grains, they can be eaten by people who suffer from cereal grain allergies.

7. CONCLUSION

According to the Thorogood (1995) ; Jew *etal*.,(2009); American Dietetic Association (2003) and Micha *et al.* (2018), the over reliance on conventional cereals like corn or wheat, and meat products may not only have negative impact on human health but increase carbon emissions associated to the food industry. Therefore, the adoption of alternative grains, legumes and tubers will become a necessity in the coming years as the population grows into nine billion by 2050, water become increasingly scarce and new food borne diseases appear (Eckstein, 2009; Suk and Semenza, 2011). Alternative foods such as amaranth, quinoa are naturally resistant to extreme weather conditions, high salinity soils and require little water for its cultivation (Jacobsen, 2003). In fact, quinoa's potential to contribute to world food security has been widely acknowledged (National Research Council, 1989; FAO, 2011), and amaranth is considered as 'food for a future' given its high quality protein and resistance to drought and heat (European commission, 2011).

In recent years, pseudocereals and alternative cereals have been attracting increased interest, both from the agricultural point of view and from aspects regarding food insecurity. One of pseudo- cereals with the worldwide major importance is amaranth (*Amaranthus sp*.). Amaranth grain provides an ideal amino acid composition for human nutrition. In particular, the content of lysine is high. Remarkable is also the high content of essential vitamins, antioxidants and fibers, which makes amaranth interesting for child nutrition. The fat of the grain is characterized by a high content of unsaturated fatty acids. Moreover, concentration of minerals is higher than in other cereals. In particular, the grain is rich in calcium, magnesium, iron, potassium and zinc. Moreover, grain amaranth has some agricultural advantages and noted ability to grow successfully in adverse environmental conditions such as high irradiance, temperature and drought. The enumerated attributes confirmed with numerous, above all fundamental, scientific information ultimately govern its food, feed, as well as some industrial application potentials. With growing concern among farmers about these pseudo grain weeds have become a topic of interest for discussion.

8. RECOMMENDATIONS AND FUTURE PROSPECTS

In spite of all the difficulties caused by quinoa and pigweeds, these plant species can offer some beneficial properties, particularly when occurring at low densities. These aspects should be utilized in the farming system, although this may make organic management more complicated than chemical based systems. Some of the potential benefits of weeds are listed below: Helping to conserve soil moisture and prevent erosion. A ground cover of weeds will reduce the amount of bare soil exposed helping to conserve nutrients, particularly nitrogen which could otherwise bleached away, especially on light soils. Food and shelter can be provided for natural enemies of pests and even alternative food sources for crop pests. The actual presence of weed cover may be a factor in increasing effectiveness of biological control of pests and reducing pest damage. Weeds can also be valuable indicators of growing conditions

in a field. With growing concern among farmers, these pseudo grain weeds have become a topic of interest for discussion. Many farmers see a potential danger in rapid invasion of these weeds in crop fields. They consider it as dangerous as other we eds like *Prosopis, Parthenium*, etc. which have become a permanent threat to their crop production. Many articles and opinion published recently have also pointed out the risks and after effects of these weeds. Other plants that can poison cattle are lupin and amaranth. Lupin is a good source of protein and energy in livestock feeds, but its use should be limited.

Thus, taking into account all aspects of its worth, we recommend the regional government, Agricultural organizations, Research institutions, Universities, NGOs and other concerned bodies to give a due attention to the farming and expansion of this blessed crop as a means of sustainable agriculture and a solution for food security and malnutrition in the region.

ACKNOWLEDGEMENTS

We are highly grateful to Vice President, Research and community service Dr. Mohammed Ahmad and Directors, research and community services for their erudite support and encouragement. Thanks are also due to the farmers and concerned people who provided us input for this article.

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Volume-1 Issue-1

The Role of Information and Communication Technology for Gender Equality: The Case of Assosa Zone, Ethiopia

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ABSTRACT

Information and Communication Technologies (ICT) allows augmented flow of information, knowledge, and exposure to the customs, norms and practices of cultures and societies. The main objective of this research is to investigate the role of ICT for gender equality. To attain the objectives of the research study designed through qualitative and quantitative research methods. The findings of the study revealed that more number of the respondents has no awareness about ICT tools. Reasons included for this ignorance are poor electricity supply, limited network coverage, lack of skill/knowledge, shortage of money to buy ICT tools and others.

Keywords: Information and Communication Technology, Gender Equality, Role of ICT for gender equality

Citation:
Shambel Ferede Assemahagn[1,2] , Hambisa Mitiku Gebre[2] (2019). The Role of Information and Communication Technology for Gender Equality: The Case of Assosa Zone, Ethiopia. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-1, pp (70-79)

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Received: 10/04/2019

Accepted: 22/05/2019

Published: 10/06/2019

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1. INTRODUCTION

A century and more after the industrial revolution, we are in the throes of another major shift in human civilization; the information revolution that has given birth to the information society. The information society is the most discussed phenomena in recent times. New information and communication technologies (ICTs), especially the Internet, have been seen as ushering in a new age. It is also true that the information age is not all rosy; the benefits of this new age have not touched all of humanity, and all its outcomes are not necessarily positive (Gurumrthy, 2004). There is now a shared understanding within the development community that development policies and actions that fail to take gender inequality into account and fail to address disparities between males and females will have limited effectiveness and serious cost implications (Derek and Chen, 2004).

There is a correlation between the level of human development and the prevalence of ICT access and use. Countries with high human development indices prove to have high ICT availability. The rapid growth and development of ICT are creating opportunities for the economic empowerment of the country and its citizenry. However, reactive and short-sighted adaptation of ICT to anchor the country's development strategy and goals is bound to contribute to the creation of new forms of economic and social inequities and greater exploitation and discrimination based on gender.

ICTs allow an increased flow of information and knowledge, increased exposure to the customs, norms and practices of other cultures and societies. This in turn tends to increase awareness of issues surrounding gender inequality. Gender inequality refers to health, education, economic and political inequalities between men and women. Gender inequalities and its social causes, impacts the sex ratio, women's health over their lifetime, their educational attainment and economic conditions. Gender inequality is a multifaceted issue that concerns men and women alike (Mishra and Kiran, 2015). ICTs can be an invaluable tool in positively changing people's attitude, by disseminating educational programs on gender equity. In addition, increased pressure from an informed constituency that are sensitive to gender inequality issues can also induce policymakers to include gender as an important component of their social and economic policies (Derek and Chen, 2004).

The development of infrastructure includes many decisions about the location of facilities, the type of technology, and issues of costs and pricing. Technological aspects can have a tremendous impact on women's access to and use of ICT. It is therefore important to complement the provision of ICT facilities with additional services and training that will build the capacities of women as well as men to act on the information and knowledge accessed through ICT (Natasha, 2003).

The General objective of this research was to investigate the role of ICT for gender equality in Assosa Zone, Ethiopia. And to achieve the main objective the specific objectives were: to describe the awareness of the population about the role of ICT for gender equality, to identify the access of ICT in the study area, to identify the factors affecting the use of ICT and to identify forms of gender inequality.

2. METHODOLOGY

2.1 Description of the study Area

Ethiopia is a country of diverse language, culture, nation, and geographical location. These made Ethiopia one of the multi exquisiteness countries in Africa as well as in the world. Ethiopia has nine regions; Benishangul-Gumuz is one of among the nine regions which found in the western part of Ethiopia with the side of Amhara and Oromia Region. The Region shares common boundaries in the west with the North and South Sudan, in the north-east with the region of Amhara, in the east and south with the Region of Oromia. The Region of Benishangul-Gumuz comprises three administrative zones; these are Metekel, Kamash and Assosa Zones. The study was conducted in two woredas ofAssosa zone namely Assosa and Bambasi woreda. From these two woredas; two kebeles from each woreda was purposively selected. By this, Amba-05 kebele and Abramo Kebele from Assosa woreda and 01 kebele and dabus kebele from Bambasi woreda

2.2 Research design

For this study, descriptive survey research design was used through quantitative and qualitative research method. This was done in order to describe the awareness of the population about the role of ICT for gender equality, identify the access of ICT in the study area, to identify the factors affecting the use of ICT, to identify forms of gender inequality and to discuss the role of ICT for gender equality.

2.3 Sampling Techniques and Sample Size

Benishangulgumuz region; Assosa zone, Bambasi (Dabus and 01 kebele) and Assosa woreda (Abramo and Amba 05) were purposely selected because of the nearness of the university and the town. And the two woredas' ICT, women's affair office coordinators and each kebele administrators were purposely selected for qualitative data. Convenience sampling was used in order to select respondents from each kebeles. It was difficult to survey the entire population because the cost of a census is too high. The three main advantages of sampling are that the cost is lower, data collection is faster, and since the data set is smaller it is possible to ensure homogeneity and to improve the accuracy and quality of the data (David s. Moore and George P., 2005).

The researchers were taking the sample of respondents from the identified woredas' of the kebeles' of community by using the following formula. The woreda's ICT and women's affair office coordinators were purposely selected.

The Sample of the respondents was taken by using the following formula.

$$n = \frac{n_0}{1 + \frac{n_0}{N}}$$

(Kothari, 2004)

Where $n_0 = \frac{Z^2_{\alpha/2} pq}{d^2}$

n= sample size

d= margin of error

N= total number of population

P=proportion population

α= level of significance

q=1-0.7=0.3

Where: d= 0.05

p= 0.7

d=0.05

$$n_0 = \frac{Z^2_{\alpha/2} pq}{d^2} = \frac{(1.96)^2 * 0.7 * (1-0.7)}{(0.05)^2}$$

Based on the formula $n_o = 322$

$$n = \frac{n_o}{1 + \frac{n_o}{N}} = 299 \text{ (sample size)}$$

The target population was the people who leave in the selected kebeles and whose age was greater than 15 years and based on this each kebele population and sample distribution were summarized below.

Table 1. Total Population of the Study and Simple Distributions

Wereda	Kebele	Total Population	Sample distributions ($n_1 = \frac{n*N_1}{N}$)
Assosa	Abramo	950	67
	Amba 05	815	57
Bambasi	01	2010	142
	Dabus	465	33
Total		4240	299

Source (based on Kebele Administrator's office report, 2008/09 E.C)

2.4 Data Source and Data Type

The primary data was collected by using questionnaires and observation from the population of the two woredas of the four kebeles and also by using interview from women's affair office and the ICT office coordinators. Secondary data was collected from available reports, records, published and unpublished documents from the concerned offices. Internet was also used to search research related works and documents required to this study.

2.5 Method of Data Collection

The data was conducted by the enumerator with the presence and supervision of the researcher. For quantitative data, the questionnaire was made; pretested and necessary modifications were made before the actual data collection was takes place. For qualitative data collection, semi-structured interview was used to collect data on the role of ICT in gender equality. The observation check list was also prepared in order to observe the role of ICT in gender equality. The question was translated for those respondents who cannot read and write English language to Amharic language by the data collector and the information from the respondent was filled accordingly. The whole data collection procedure was closely supervised by the researchers.

2.6 Method of Data Analysis

The collected quantitative data was processed using SPSS software version 20.0; in that, descriptive statistics was used to put the result in the form of tables, charts, graphs. Qualitative data was collected and the result of the finding of qualitative data was displayed in the form of narrations, explanations, concepts, and opinions.

3. RESULT AND DISCUSSION

3.1 Demographic Characteristics of the Respondents

Two hundred ninety nine (299) questionnaires were prepared and distributed but one hundred eighty two (182) questionnaires were returned. Therefore, the analysis

and interpretation were made on the basis of the frequency of responses given by those 182 respondents.

The general demographic characteristics of respondents indicate that, 182 respondents were involved in the study. 96 (52.7%) were male and 86 (47.3%) were female, 115 (63.2%) of the respondents were married, 44 (24.2%) were single and 23 (12.6%) were divorced; 72 (39.6%) of respondents were categorized in age range between 20-29 years, 70 (38.5%) of respondents were categorized in the year 30-39, 36 (19.8%) of respondents were categorized in the year 40-49, and 4 (2.2%) of respondents were categorized 50-59 years.

29 (15.9%) of the respondents were illiterate, 52 (28.6%) of the respondents were only the ability to write and read, 16 (8.8%) of the respondents were grade 8^{th} complete, 33 (18.1%) of the respondents were grade 10^{th} complete, 1 (0.5%) of respondent were grade 12^{th} complete, 30 (16.5%) of the respondents were diploma holders, and the remaining 21 (11.5%) of the respondents were bachelor degree holders.

3.2 Awareness of the Population about the Role of ICT and ICT Accessibility

The awareness of the population about the role of ICT on gender equality was identified by measuring their familiarity and usage of ICT tools.

The respondents who were familiar with ICT tools can access information based on their interest and those who can access information might have awareness about the role of ICT for gender equality. Based on the respondents response the result was displayed below.

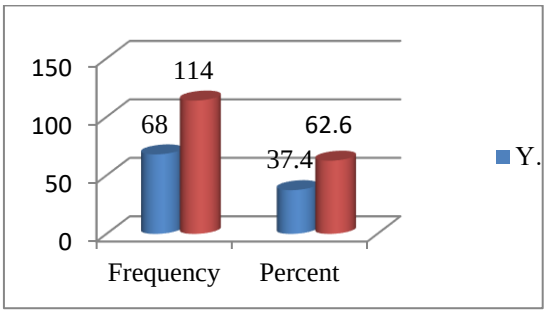


Fig. 1. Respondents Familiarity with ICT

As indicated on the figure 1, 114 (62.6 %) respondents were not familiar with ICT but 68 (37.4%) of the respondents were familiar with ICT.

Table 2. Way of Familiarity with ICT

Way of familiarity with ICT	Frequency	Percent
Through Self-study	7	10.3
Through Friends	7	10.3
Through Training	9	13.3
Through Learning in schools	33	48.5
Through Media	6	8.8
Others	6	8.8
Total	68	100.0

Table 2 shows the respondents were familiar with ICT were through learning in schools 33 (48.5%), through training 9 (13.3%), through self-study 7 (10.3%),

through friends 7 (10.3%), through media 6 (8.8%) and others 8 (8.8%) and also the researchers were interviewed the kebele administrators and wereda ICT coordinators about the familiarity of the people with ICT and they confirmed that there were people who were not familiar with ICT tools.

3.3 Use of ICT for Gender Equality

The respondents were asked whether they know the use of ICT or not and their response was summarized as follows.

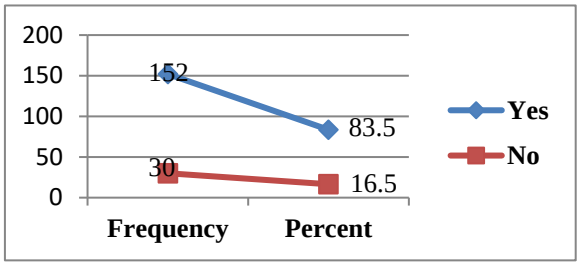


Fig.2. Use of ICT knowhow

As indicated on the above figure 2, 152 (83.5%) knew the use of ICT for gender equality but 30 (16.7%) of the respondents didn't know about it.
According to respondents' response on the use of ICT for gender equality, the respondents who have knowhow the use of ICT, ICT usage summarized as follows.

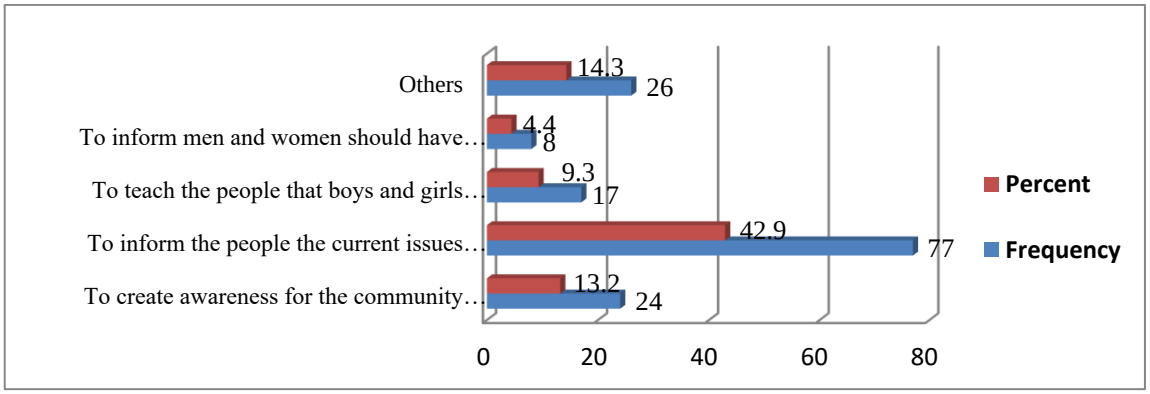


Fig.3. Use of ICT

As indicated on the figure 3, 77 (42.9%) were used ICT to inform the people the current issues what exist in the world, 24 (13.2%) of the respondents used ICT to create awareness for the community about rights and responsibilities, 17 (9.3%) of the respondents used ICT to teach the people that boys and girls have equal opportunity in education, 8 (4.4%) of the respondents were used ICT to inform men and women should have equal payment for similar work and 26 (14.5%) of the respondents were used ICT for other purposes in combination with the listed purposes. The researchers were also interviewed kebele administrators and woreda ICT and gender affairs office coordinators about the use of ICT for gender equality and the answered similar with the above.

3.4 ICT Accessibility

To identify the accessibility of ICT in the study area, the researchers were asked the selected respondents about ICT access.

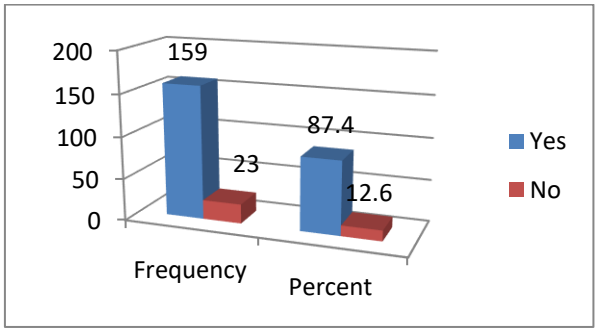


Fig. 4. ICT's Access

As shown on the above figure 4, 159 (87.4%) respondents were said that there was ICT access; whereas 23 (12.6%) of them said as there is no ICT access. For respondents that said there is ICT access in their community was asked which ICT tools were accessible in their community and their answers summarized on the following table.

Table 3. ICT Accesses in the Community

ICT accesses in the community	Frequency	Percent
Radio	77	48.4
Television	21	13.2
Computer Center	2	1.3
Mobile	15	9.4
Others	44	27.7
Total	159	100.0

As indicated on the above table-3, 77 (48.4%) of the respondents said radio was accessible, next 21 (13.2%) television access, 15 (9.4%) mobile access, 2(1.3%) computer center and 44 (27.7%) other ICT accessibilities in combining with radio, television, mobile and computer center.

3.5 Factors That Affect the Use of ICT and Forms of Gender inequality

The following statements were distributed for respondents to identify the factors that affect the use of ICT. Each statement was given value by respondents based on a five level Likert scale as a value of 1 was assigned to 'Strongly disagree', 2 'Disagree', 3 'Neutral', 4 'Agree', and 5 'Strongly agree'.

Table 4. Factors that Affect the Use of ICT

	Frequency	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
There is shortage of money to buy ICT tools	N	9	12	50	60	51
	%	4.9	6.6	27	33	28

Lack of Skills to use ICT tools	N	27	31	33	82	9
	%	14.8	17	18.1	45.1	4.9
lack of Electric power	N	24	31	50	45	32
	%	13.2	17	27.5	24.7	17.6
Limited network coverage	N	37	63	56	24	2
	%	20.3	34.6	31	13	1.1
Lack of time to use ICT	N	62	88	25	6	1
	%	34.1	48.4	13.7	3.3	0.5
language problem to use ICT	N	16	112	35	17	2
	%	8.8	62	19	9.3	1.1

As shown in table 4, 9 (4.9%) of the respondents were selected strongly disagree, 12 (6.6%) respondents selected agree on the statement 'There is shortage of money to buy ICT tools ' and 50 (27%) respondents chosen neutral but 60 (33%) of the respondents were chosen agree and 52 (28%) of the respondents were chosen strongly disagree.

9 (4.9%) of the respondents strongly agreed, 82 (45.1%) respondents agreed on the statement 'Lack of Skills to use ICT tools' and 33 (18.1%) of respondents were selected neutral but the remaining 31 (17%) respondents were disagreed and 27 (14.8%) respondents were strongly disagreed.

24 (13.2%) of the respondents were picked strongly disagree, 31 (17%) respondents were chosen disagree on the statement 'lack of Electric power' and 50 (27.5%) of the respondents preferred neutral, but 45 (24.7%) of the respondents were chosen agree and 32 (17.6%) respondents were chosen strongly agree.

2 (1.1 %) of the respondents selected strongly agree, 24 (13%) respondents selected agree, 56 (31%) of the respondents selected neutral, 63 (34.5%) respondents were disagreed and 37 (20.3%) respondents were strongly disagreed on the statement 'Limited network coverage'.

On the statement 'Lack of time to use ICT', 62 (34.1%) of the respondents strongly disagreed, 88 (48.4%) of respondents disagreed, 25 (13.7%) of the respondents chosen neutral, 6 (3.3%) respondents agreed and 1 (0.5%) respondent strongly agreed.

16 (8.8%) of the respondents strongly disagreed, 112 (62%) respondents disagreed on the statement 'language problem to use ICT' and 22 (22.9%) of respondents had chosen neutral but 17 (9.3%) respondents agreed and 2 (1.1%) strongly agreed. On

this statement some respondents were told for the researchers about language problem. And they said the Broadcast Corporation should increase the airtime of programs dispersed by indigenous language. The researchers were also interviewed the kebele administrators and woreda gender affairs office coordinator to encapsulate the factors that affect the use of ICT in the study area. They said there were lack of enough electricity, limited network, economic factor, and others.
Regarding with the forms of gender inequalities; the respondent's response was tabulated as the following.

Table 5. Forms of Gender Inequalities

What are the forms of gender inequalities	Frequency	Percent
In Education	23	12.6
In health care	8	4.4
Economy	108	59.3
Child preference	22	12.2
Others	21	11.5
Total	182	100.0

As indicated on table 5, 23 (12.4%) of respondents said there was education inequality, 8 (4.4%) of the respondents said there was health inequality, 108 (59.3%) of the respondents said there was economy in equality. Based on the check list also the researchers tried to assess this and most of the people especially female labors were said there was inequality on payment even they were worked more time and more work but paid lower than men (e.g. construction laborers). 22 (12.2%) of the respondents were said there was a discrimination of child based on sex (gender). 21 (11.5%) of the respondents chosen others with a combinations of the above.

3.6 ICT Role for gender equality

In general, ICT includes any communication device or application encompassing radio, television, phones, computers etc. Socially the majorities of developing countries women are still tradition bound and are in detrimental position. if there is ICT accessibility ICT has benefits to empower women through informing the community; for instance through ICT the people can broad cast opinions in positive way about gender equality, can increase mutual relations, can do business, and others. The features of ICTs and its overall benefits for economic development makes it a key component through which gender equality can be improved. Especially in a developing country, this can be a good strategy by inducing policymakers to include gender as an important component to their social and economic policies. In the areas of the industry like health and education, ICT can be more focused on improving the lives of women in more rural areas (Derek and Chen, 2004). Based on the check list the researchers were tried to ask some rural women about the role of ICT in their community; one woman was said like this *'through watching television I have got a lesson by attending 'Chilot' drama weekly on EBC (Ethiopian Broadcasting Corporation) about how a man and a woman can divide their property when they become divorced. But in our community the traditional way of judging the division of property for a man and a woman when they divorced was favored for a man and after I got this lesson, I told for the community and they accepted me. Now in our community we all have equal right.'*

This revealed that ICT/broad cast/ has a paramount importance to teach the people about equality and diverse issues. The government or regional government or zone administrators, or woreda administrators or non-governmental organizations or the concerned body should work on it to add more programs that enable the community/citizen/ to become informed or knowledgeable.

4. CONCLUSION

The findings revealed that 62.6% of the respondents were not familiar with ICT. However, most of the respondents knew the use of ICT for gender equality and more than half of the respondents used radio to get information. Shortage of money, lack of skills or knowledge to use ICT tools, limited network coverage, and lack of electric power, language problem and others were the factors that affect to use ICT in the study area. And also economy inequalities, education inequalities, health care inequalities, child preference and others were the forms of in equalities which were happened in the study area. Hence, the study concluded that ICT tools have a boundless importance to inform the people about gender equality or the rights and responsibilities of the people evidently. The following recommendations are given based on the findings:

i. The stakeholders should work to increase the awareness of the people about ICT.
ii. ICT infrastructures should be fulfilled for rural areas to enable the people knowledgeable about gender equality, the agricultural activities and others.
iii. The airtime of Radio or any other media should be increased that may teach the community including indigenous language.
iv. Governmental organizations, nongovernmental organizations and all the people should cooperatively work to eliminate the inequalities which occur based on gender.
v. To eliminate gender discrimination further research or project is recommended in the region, country.

ACKNOWLEDGEMENTS

We thank all the respondents for their convenient responses & Assosa University for providing us research fund.

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Quality of Education with the Focus of Faculty Competencies, Research Leads Student Cognitive and Collaborative Learning Techniques in the Class Room

Mekapotula Srinivasa Chakravarthi[1]

ABSTRACT

In this paper the faculty competencies, research leads student cognitive and collaborative learning techniques in the class room; supports to meet the current generation and future generation requirements with higher impact with the student development in educational institutions. The global idea of collaborative learning techniques in many ways interlinked with the quality of education and the community development. This will go a long way in the "designing of an optimal professional teaching mechanism" for colleges and Universities of Afar region, Ethiopia. This leads to contribute to student development while improving the knowledge as well as of the local community and society at large. The results indicate that collaborative learning is a cognitively and emotionally challenging learning process. The way in which group members share and develop their ideas depends on how actively they monitor their own and each other's evolving understanding. However, monitoring cognitive activities as a group is only one part of effective and enjoyable learning. Methodologically, this study provides several process-oriented analysis schemas for analyzing cognitive activities within collaborative learning. Practically, this study offers teachers and educational professionals' ideas for the design of collaborative learning environments. Further research is, however, needed to explore the collaborative learning characteristics of well- and poorly functioning groups.

Keywords: Faculty, Student, Collaborative Learning Techniques, Cognitive Activities, Quality of Education, Community and Research.

Citation: Mekapotula Srinivasa Chakravarthi (2019). Quality of Education with the Focus of Faculty Competencies, Research Leads Student Cognitive and Collaborative Learning Techniques in the Class Room. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-1, pp (80-88)

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Received: **30**/04/2019

Accepted: **02**/06/2019

Published: 10/06/2019

OPEN ACCESS

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1. INTRODUTION

The quality and value of an undergraduate education in the past decade received, and continues to receive, scrutiny by various stakeholders associated with the higher education community. Much of the energy surrounding the undergraduate experience and student learning was placed on the two major responsibilities of faculty, teaching and research (Fairweather, 1996, 2002; Marsh & Hattie, 2002). The regulation of time allocated to these two roles was quickly becoming one of the most salient issues in higher education. Unfortunately, much of the debate about the nature of faculty work was shrouded in myth, opinion, and conjecture (Fairweather, 2002). Myths, such as a faculty member being highly involved in teaching, engages students in the undergraduate experience resulting in greater student learning gains were important to debunk or substantiate. As a result, assessing the impact that faculty behaviors and interactions with students in the classroom have on the undergraduate classroom experience was ripe for examination in the current study. Conducting empirical research that focus on faculty behaviors and interactions with students in the classroom will advance the literature on the role faculty play in student learning.

In recent years the amount of research focusing on how thinking can be developed by systematic activities has grown rapidly, as cognitively based research on how learning is connected to successful thinking and to creativity. The brain uses two systems to solve problems and to learn (Björklund, 2008; Kahneman, 2011). An explicit system helps us to analyze information and remember things while we work or solve problems (Klingberg, 2011). An implicit system stores data from experiences on a subconscious level (Björklund, 2008). People tend to use the more impulsive and intuitive implicit system to avoid the effort of using the explicit system when confronted with tasks demanding logical thinking (Kahneman, 2011). However, the implicit memory is more sustainable and will be reliable if the bank of implicit memories is large (Björklund, 2008). Complex learning takes longer and requires incubation, pauses from learning.

The approaches that faculty take to effective educational practices (Kezar, 1999). Kuh (2001) and Pascarella (2001) posited that a quality undergraduate education was one that engaged students in proven good educational practices (e.g., focus and quality of undergraduate teaching, interactions with faculty and peers, and involvement in coursework) and that added value to student learning. Studying self-reported student engagement behaviors was important and a necessary step in measuring the quality of undergraduate education; yet, it was equally important to understand and evaluate what faculty practices influenced student learning gains (Wingspread Report, 1993). A good deal was known about how faculty spends their time, what instructional methods they used, and satisfaction with teaching (Menges, 2000).

Research on good thinkers or experts within their field, for example scientists and artists show that experts have a rich experience and understanding of their subject and

its established knowledge base (Björklund, 2008; Willingham, 2009). Critical thinking includes elements of creativity and independence or it would not be possible to make the connections needed to make evaluating and analyzing conclusions. Specifically, examine the context created by faculty collaborative learning techniques and its relationship to student engagement with cognitive activities in the class room, student perceptions of society, and student attitude.

The objective of the research is to provide quality of education through the student's cognitive activities and to collaborative learning techniques with faculty competencies and research supports the development of the students and community

2. REVIEW OF LITERATURE

Barr and Tagg (1995) suggested a paradigm shift to improve the quality of undergraduate education (i.e., from providing instruction to students, to producing student learning) that would create learning centered campuses and maximize students' learning. However, creating a student-centered campus necessitates knowing how students learn, understanding barriers to student learning, and developing classroom techniques that promote learning among college students (Stage, Muller, Kinzie, & Simmons, 1998).

Astin's (1993) model of inputs-environments-outcomes assessed the impacts that various institutional practices and environmental experiences (e.g., faculty-student contact, pedagogical techniques) have on student outcomes (e.g., student engagement and student learning).

Collaborative learning as a special form of learning and interaction has been theoretically operationalized, for example, using terms of knowledge acquisition versus participation (Sfard 1998), knowledge building (Scardamalia & Bereiter 2003), knowledge creation (Paavola et al. 2004) and as a process supported by technology (i.e.CSCL as discussed in Stahl 2006, Stahl et al. 2006). All these approaches and descriptive metaphors aim to target active and dynamic processes within the group and the community (Crook 2000).

3. CONCEPTUAL FRAME WORK

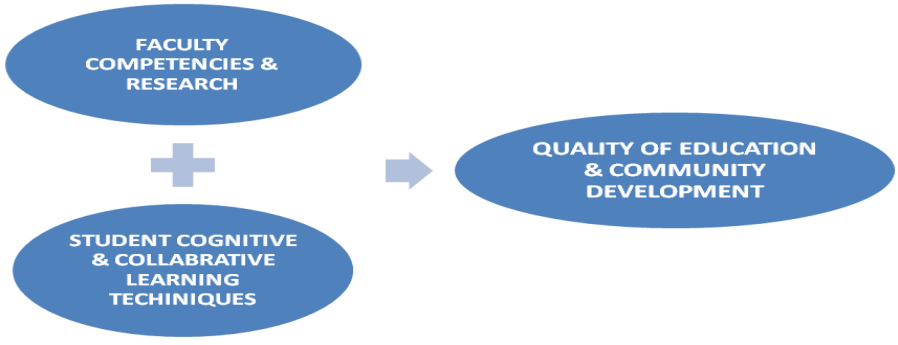


Fig.1 Conceptualization of Quality of Education

4. COLLABORATIVE LEARNING

The study of group learning began long before studies of collaborative learning or computer-supported collaborative learning (CSCL). Research over small groups has a long history, for example within social psychology. To differentiate collaborative learning from its earlier investigations of group learning, it is useful to follow Dillenbourg's (1999) distinction between cooperative and collaborative learning. The often cited difference between these concepts is in the division of labour, where the cooperative form of learning interaction is characterized as the division of sub-tasks and responsibilities, whereas collaborative learning entails shared learning activities (Roschelle & Teasley 1995).

"Collaborative learning" is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Collaborative learning activities vary widely, but most center on students' exploration or application of the course material, not simply the teacher's presentation or explication of it.

5. COLLABORATIVE LEARNING APPROACHES

Collaborative learning covers a broad territory of approaches with wide variability in the amount of in-class or out-of-class time built around group work. Collaborative activities can range from classroom discussions interspersed with short lectures, through entire class periods, to study on research teams that last a whole term or year. The goals and processes of collaborative activities also vary widely. Some faculty members design small group work around specific sequential steps, or tightly structured tasks. Others prefer a more spontaneous agenda developing out of student interests or questions. In some collaborative learning settings, the students' task is to create a clearly delineated product; in others, the task is not to produce a product, but rather to participate in a process, an exercise of responding to each other's work or engaging in analysis and meaning-making.

5.1 Cooperative Learning

Cooperative learning represents the most carefully structured end of the collaborative learning continuum. Defined as "the instructional use of small groups so that students work together to maximize their own and each other's learning" (Johnson et al. 1990), cooperative learning is based on the social interdependence theories. In cooperative learning, the development of interpersonal skills is as important as the learning itself. The development of social skills in group work-learning to cooperate – is key to high quality group work. Many cooperative learning tasks are put to students with both academic objectives and social skills objectives.

5.2 Problem-Centered Instruction

Problem-centered instruction, widely used in professional education, frequently is built around collaborative learning strategies. Many of these springs are from

common roots, especially the work of John Dewey in the early part of this century. These methods are;

a. **Guided Design**: The approach asks students, working in small groups, to practice decision-making in sequenced tasks, with detailed feed-back at every step.
b. **Cases**: Case method teaching frequently asks small groups of students to tackle cases in class or in study group sessions.
c. **Simulations**: Simulations are complex, structured role-playing situations that simulate real experiences.

5.3 Writing Groups

Both in theory and practice, the most concentrated effort in undergraduate collaborative learning has focused on the teaching of writing.

5.4 Peer Teaching

With its roots in one-room schoolhouse tradition, the process of students teaching their fellow students.

5.5 Discussion Groups and Seminars

The terms discussion group and seminar refer to a broad array of teaching approaches. In college settings we usually think of discussions as processes, both formal and informal, that encourage student dialogue with teachers and with each other.

5.6 Learning Communities

Learning communities are a delivery system and a facilitating structure for the practice of collaborative learning.

6. COGNITIVE

Cognition is "the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses"(Oxford dictionary). It encompasses processes such as attention, the formation of knowledge, memory and working memory, judgment and evaluation, reasoning and "computation", problem solving and decision making, comprehension and production of language. Cognitive processes use existing knowledge and generate new knowledge.

Cognitive skills and knowledge involve the ability to acquire factual information, often the kind of knowledge that can easily be tested. So, *cognition* should be distinguished from social, emotional, and creative development and ability. *Cognitive science* is a growing field of study that deals with human perception, thinking, and learning.

7. RESPONSIBILITIES OF COLLEGE AND UNIVERSITY FACULTY

a. Prepare and conduct lectures and seminars to undergraduate and graduate students
b. Publish empirical and theoretical research in a variety of scholarly journals
c. Advise students with respect to academic performance, career opportunities, and pursuit of advanced degrees

d. Mentor and advise new academics, typically teaching assistants, research assistants, and junior faculty members
e. Carry out administrative and managerial duties, including chairing committees, serving as head of an academic department, and representing the university in the community at large

8. COMPETENCIES OF FACULTY

The competencies in the Education Competency Wheel will be important for Teachers from time to time; the 13 described here rose to the top of the list. This profile includes competencies that are relevant for faculty at both teaching and research universities.

8.1 Compassion

Genuinely cares about people; is concerned with their academic and non-academic problems; is available and ready to help; demonstrates real empathy with the joys and pains of others.

8.2 Creativity

Generates many new and unique ideas; makes connections among previously unrelated notions; is unafraid to use unorthodox methods; is seen as original and value-added in brainstorming settings.

8.3 Developing others

Is a people builder; provides challenging and stretching tasks and assignments; constructs compelling development plans and executes them; pushes direct reports to accept developmental moves.

8.4 Integrity and trust

Is widely trusted; is seen as a direct, truthful individual; presents truthful information in an appropriate and helpful manner; keeps confidences; admits mistakes; doesn't misrepresent himself or herself for personal gain.

8.5 Intellectual acumen

Is intelligent and capable; deals with concepts and complexity comfortably; is good at learning and deciphering new knowledge; able to assimilate new skills independently.

8.6 Interpersonal skills

Is warm and easy to approach; builds constructive and effective relationships; uses diplomacy and tact to diffuse tense situations; has a style and charm that immediately puts others at ease and disarms hostility.

8.7 Listening

Practices attentive and active listening; has the patience to hear people out; can accurately restate the opinions of others even when he or she disagrees.

8.8 Motivating others

Creates a climate in which people want to do their best; can assess each person's strengths and use them to get the best out of him or her; promotes confidence and optimistic attitudes; is someone people like working for and with.

8.9 Personal learning and development

Is personally committed to and actively works to continuously improve himself or herself; recognizes the need to change personal, interpersonal, and managerial behavior; actively seeks feedback.

8.10 Presentation skills

Is effective in a variety of formal and informal presentation settings; commands attention and manages group process during the presentation; is cognizant of audience response and able to adapt content and style accordingly.

8.11 Time management

Uses his or her time effectively and efficiently; concentrates his or her efforts on the most important priorities; adeptly handles several tasks at once.

8.12 Valuing diversity

Manages all kinds and classes of people equitably; supports equal and fair treatment and opportunity for all; fosters a climate of inclusion, where diverse thoughts are freely shared and integrated.

8.13 Written communications

Is able to write clearly and succinctly in a variety of communication settings and styles; can get messages across that instigate appropriate actions.

9. RESEARCH PROFICIENCY

The researcher strives towards proficiency in a research area, and uses the theory to expand his/her knowledge by looking through a specific theoretical lens. To the teacher, on the other hand, observation and analysis are part of the continuing work to assess every student's learning, and how the student's experiences and thinking can be guided (cf. Shulman, 2004).

The teacher will have to master many different theoretical tools to see solutions to the practical problems and challenges that occur in the complex school / college's context or the teacher's praxis theory might lead him/her to mechanically solving all students' problems in the same way with limited success.

10. CONCLUSION

To conclude, the need for an emotional balance within group is clear when one considers the cognitive, motivational and emotional challenges of collaborative learning (Järvenoja & Järvelä 2009, Kirschner *et al.* 2006). However, more research needs to be carried out in order to understand how emotions circulate and interact with knowledge elaboration in natural settings. In the future, more specific theoretical models are needed that explicitly address the interplay between individual cognition, emotion and motivation with interpersonal communication and regulation, in the context of a collaborative learning environment.

The paper analyzes how education in schools/ colleges meets the demands for cognitive development, particularly critical thinking and creativity of students. The anticipated criteria were hard to reach in most of the observed classrooms. Though most teachers showed an understanding of what would develop the students cognitively, they lacked the understanding to translate this knowledge into practice.

The teachers tended to plan focusing what should be taught rather than students' cognition.

Intelligence seems to be the result of an individual combination of unique biological dispositions that can be developed and refined, presumably in school / colleges. The teacher will have to meet with several challenges when trying to teach the students productive thinking: Balancing what is valued in society with teaching critical thinking and creativity, coping with traditional expectations on what a classroom context and a qualitative lesson ought to be, and considering how thinking, intelligence, and creativity are developed.

Underlying theoretical ideas will most likely result in different interpretations of what should be done in the classroom. There are few practical role models to turn to, when teachers try to find a pedagogy for the future. This paper will explore how the teachers cope with some of the challenges of teaching good thinking.

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Volume-1 Issue-2

GROWTH, YIELD AND NITROGEN USE EFFICIENCY OF GREEN BEAN (*Phaseolus vulgaris* L.) AS INFLUENCED BY RATE OF BIOCHAR AND NITROGEN FERTILIZER AT JIMMA, SOUTHWESTERN ETHIOPIA

Osman Ahmed[1], Amsalu Nebiyu[1], Milkiyas Ahmed[1]

ABSTRACT

Based on the national soil database, most of the southwest Ethiopian soils are deficient in macronutrients (Nitrogen) and affected by ongoing acidification problems. This has affected growth, yield and NUE of legumes in general and that of green beans in particular. However, studies on the combined application of inorganic and organic fertilizer or amendments to improve the growth yield and NUE of green bean is scant. Therefore, a pot experiment was conducted to determine the rate of biochar and nitrogen fertilizer on growth, yield and NUE of green bean on the acidic soil of Jimma in 2017/2018. The treatments consisted of four biochar rates (0, 2, 4 and 6 t ha^{-1}) and four nitrogen fertilizer rates (0, 23, 46 and 69 kg ha^{-1}) and laid out using 4x4 factorial arrangements in a randomized complete block design with three replications. ANOVA show that combined application of biochar and Nitrogen fertilizer highly significantly ($P<0.001$) total pod yield, nitrogen use efficiency and soil pH, total nitrogen and organic carbon. The highest pod yield (48.72g $plant^{-1}$), NUE (12.69 gg^{-1}) was obtained from the combined application of 6 t biochar and 23 kg N fertilizer ha^{-1} , The highest total number of nodules (121.33) at 2 t ha^{-1} BC +23 kg ha^{-1} N fertilizer and the highest soil pH (6.01) resulted when the pots received of 6 t biochar ha^{-1}alone. Therefore, The improved soil chemical properties, pod yield, and nitrogen use efficiency through combined use of biochar and N fertilizer suggests the importance of integrated use of biochar with N fertilizer to ensure that green bean crops are adequately supplied with N for NUE and total pod yield in tropical acid soils for sustainable green bean production in the long term.

Keywords: Acidic soil, Amendment, Coffee husk, Feedstock, Pod yield, Pyrolysis, Soil fertility

Citation: Osman Ahmed, Amsalu Nebiyu, Milkiyas Ahmed (2019). Growth, Yield And Nitrogen Use Efficiency Of Green Bean (*Phaseolus Vulgaris* L.) As Influenced By Rate Of Biochar And Nitrogen Fertilizer At Jimma, Southwestern Ethiopia. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-2, pp (1-11)

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Received: 03/07/2019

Accepted: 20/08/2019

Published: 29/12/2019

OPEN ACCESS

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1. INTRODUCTION

Green bean is one of the most cultivated leguminous vegetables in the world and highly valued as sources of many vitamins and minerals and provides more vitamin A and C, calcium, starch and protein (Negash, 2007). It is produced worldwide for export and canning industries. In 2014/2015, world production of green bean was 21.7 million tons from the total area of 1.5 million ha and 7 million tons from the total area of 75,885 ha in Africa. While in Ethiopia, its production was 6,486 tons from a total area of 1,576 ha. With average productivity of 4.12 tons ha^{-1} which is very low as compared to the world average productivity of 14.22 t ha^{-1} (FAOSTAT, 2017).

In Africa, the crop has low yield and quality due to both biotic (disease and pests, lack of improved varieties) and abiotic factors (soil related problems, including N deficiency) are the most common problems (Katungi *et al*., 2010). Similarly, In Ethiopia, the low yield of the crop is attributed to declining of soil fertility, rainfall variability, pest pressure, poor agronomic practices and poor accessibility to quality seed (Katungi *et al.,* 2010). Especially the problem associated with soil acidity is one of the problems constraining green bean productivity (Abebe, 2007). On the other hand, the problem may be attributed to a limited utilization of input for its production as it is taking place on smallholder farms (Dessalegn, 2003, Ferris and Kaganzi, 2008). However, the N fertilizer requirement for the green bean is high due to its weak fixation capacity of atmospheric N compared to other legumes in addition; protein and mineral concentrations of green bean can be affected by poor agronomic practices, including N fertilizer utilization (Abubaker, 2008; Ahmed *et al.,* 2010).

Generally, in Ethiopia soil fertility management is limited and the application of fertilizer by smallholder farmers mainly depends on the blanket recommendation (i.e. 46 kg N ha^{-1}) for the green bean in which it was practiced regardless of the production area, soil type and fertility status (MoANR, 2016). Soil studies in Jimma area indicated that decline of total N which is below the critical level due to N leaching problems as the area receives high rainfall and farmers have a limited cultural practice to integrate chemical N fertilizer with organic amendments in their farmlands. On the other hand, soil acidity problems due to the presence of toxicity of (Al) and (Mn) and poor availability of essential plant nutrients such as P and N were also reported by different authors (Kochian *et al.,*2004; Nigussie *et al.,* 2013).

Many studies showed that increasing N levels of application improved the plant growth, yield and pod quality (Mahmoud *et al.,* 2010). However, the increased cost of inorganic fertilizers and application of recommended dose is difficult to be afforded by the smallscale farmers. Even application of recommended mineral fertilizers does not improve the negative nutrient balance due to the high nutrient removal from the soils (Eichler *et al.,* 2007). Hence, easily accessible and low-cost sources of plant nutrients for supplementing and enhancing chemical fertilizers should be substituted. In this context, integrated nutrient management would be a viable strategy for efficient use of chemical fertilizers with matching addition of organic soil amendments (Eichler *et al.,* 2007). Biochar is recently well known organic component of an integrated nutrient

supply system, which improves soil health, increase productivity and releases some amount of macro and micronutrients (Bass *et al.,* 2016).
Studies reported that positive interactions were observed when N fertilizer and biochar were applied together and more N fertilizer remained in the biochar-amended soil than not amended (Chan and Steiner, 2008). Furthermore, the ability of biochar to retain N and prevent its leaching can increase N fertilizer use efficiency, thereby maintains crop yield under smaller nitrogen inputs (Zhang *et al*., 2015). There is also evidence that showed use inefficiency of applied N fertilizer due to N losses from leaching is widespread. But this problem is alleviated by using biochar due to its specific properties like an ability to increase soil pH, CEC, nutrient recycling and carbon sequestration (Liu *et al.,* 2012). More importantly, biochar has the tendency to inhibit NO_3^- N transformation from applying N fertilizers and hence the use efficiency of applied N could be enhanced particularly under acidic soil conditions. Moreover, the use of inorganic fertilizers with organic fertilizers or amendments is not well understood by smallholder farmers and appropriate rate of inorganic and organic fertilizer sources for enhanced green bean production under Jimma condition is lacking. Therefore, this study was done to investigate the effect of coffee husk biochar and N fertilizer on soil chemical properties and pod yield, N use efficiency of green bean.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The pot experiment was conducted at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM), Horticulture and Plant Science Department research lath-house. The site is located at 7^0 42'N Latitude, 36^0 47' E longitude and altitude of 1710 meters above sea level. The area receives an annual rainfall of 1819.8 mm. The maximum and minimum temperature of the area is 31.8^0 C and 8.5^0 C, respectively. The soil of the area was characteristically reddish brown clay soil with pH from 5.5 to 6.0 (NMA, 2015).

2.2 Biochar Production

Biochar from coffee husk was prepared at JUCAVM by using pyrolysis unit at temperature of 500^0 C with 3 hours of retention time as suggested by Lehmann (2007) and Bayu *et al.* (2015). After the pyrolysis, it was watered to cool down, air dried, put into sacks, took required amounts, grounded to small granules and passed through a 2 mm sieve in order to have the same particle size as that of the soil (Bayu *et al.*, 2015). Finally, it was subjected to laboratory analysis to determine some selected chemical properties.

2.3 Treatments, Experiment Design and procedures

The pot experiment was laid out in randomized complete block Design (RCBD) in 4x4 factorial arrangement with combinations of four levels of biochar (0, 2, 4 and 6 t ha^{-1}) and four levels of nitrogen (0, 23, 46 and 69 kg N ha^{-1}) with three replications. One hundred kilogram (100 kg) urea (blanket recommendation) was used as a reference to

set the N treatments. Totally, there were 16 treatment combinations, which were randomly assigned to each pot.

The experiment was conducted with 96 pots and each pot was tagged for identification purpose. The plastic pots having five kg capacity with upper (28 cm) and lower (25 cm) surface diameter and height (30 cm) were filled with five kg of dry soil with different levels of biochar before planting and nitrogen levels at planting. Before the pots were filled with soil, the soil was air dried for 72 hours, crushed finely and weighted as required.

The lath house used for this experiment did not have the required facilities to control weather conduction inside (have open spaces at a number of places so there was difference in rain droplet and sunlight).

Finally, green bean variety B.C4.4 seed were obtained from Melkasa Agricultural Research Center and four seeds were sown per pot and when the seedling had trifoliate leaves, one poorly established seedling per pots were removed to avoid excessive competition among plants (leave six total number of plants per experimental unit) and other agronomic management practices were held as recommended.

2.4 Soil Sampling and Analysis

The soil sample for this experiment was collected from Jimma Agricultural Research Center (JARC) whose pH has been determined to be strongly acidic (pH_w = 4-5). Five soil samples were collected in a diagonal pattern from a depth of 0 to 30 cm by using an auger and bulked to obtain one sample. The sample was air dried, ground using a pestle and mortar and allowed to pass through a 2 mm sieve. Before commencement of the experiment the soil sample (1kg) and the biochar were analyzed for physical and chemical properties using standard laboratory procedures at Jimma Agricultural Research Center Soil and Plant tissue Chemistry Laboratory.

2.5 Plant Sampling for Nitrogen Content Analysis

The shoot part of the plant was collected from each pot at harvesting stage, washed by distilled water, dried using oven dried (70^0 C for 48 hours at constant weight) then grounded to pass 1 mm sieve size and subjected to wet digestion and analyzed for total N content by Kjeldahl procedure.

2.6 Data Collection

2.6.1 Growth and yield Parameters

1. Total Pod Yield (kg/plant): - Total weight of pods was determined from pods harvested from each plant per pot at harvesting time and weighed using sensitive balance (CTG-6H+).

2. Nitrogen use efficiency (NUE) is the efficiency with which soil nitrate-N is converted into grain N. The NUE in plants was calculated in terms of the nutrient efficiency ratio (NER), as reported by Baligar *et al.,* (2007) and expressed as total nitrogen use efficiency in gram $gram^{-1}$.

Nutrient Efficiency Ratio (NER) = $\frac{Units\ of\ yield\ (g)}{Units\ of\ nutriens\ in\ plant\ tissue\ (g) due\ to\ applied}$ gg^{-1}

2.7. Data Analysis

Before analysis, all the data's collected were checked for its normality and then, subjected to analysis of variance (ANOVA) using general linear model in SAS software version 9.3 (SAS Institute Inc. 2012). For parameters showing significant differences, mean separation between treatments were carried out using least significant difference (LSD) test at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Effect of Biochar and Nitrogen Fertilizer Rate on pod yield and NUE Parameters

3.1.1 Total Pod Yield per Plant (g)

The main effects of BC and N fertilizer rates and their interaction had highly significant ($P<0.001$) effect on total pod yield per plant (Appendix Table 1). The highest total pod yield per plant (48.72 g) resulted from application 6 t BC with 23 kg N ha^{-1} which was statistically in parity the yield obtained from 6 t BC with 46 kg N ha^{-1} (Table 1). On the other hand, the lowest total pod yield per plant (24.90 g) was recorded from the control treatment.

The possible reasons for the maximum pod yield per plant observed from the higher combined application of BC and N fertilizer could be due to the quick response of green bean and character of BC has large surface area, high cation exchange capacity and high pH this enable BC to has the potential to control the rates of nitrogen cycling by enhancing the soil content of NH_4^+ and NO_3^- through direct adsorption or reducing the emission of N_2O and losses of N leaching or increasing the population of nitrifying soil bacteria for biological N retention (Clough and Condron, 2012). These results are in agreement with the works of Van Zwieten *et al.* (2010) who reported that the combined application of BC and N fertilizer highly increases crop yield. Songkrit *et al.* (2017) also reported that the addition of 5 and 10% (w/ w) cassava steam BC to the soil increased the total pod yield of green bean.

3.1.2 Nitrogen Use Efficiency (NUE)

The main effects of BC and N fertilizer rates and their interaction had highly significant ($P< 0.001$) difference on NUE of green bean (Appendix Table 2). The highest NUE (12.69 gg^{-1}) was resulted from BC rate of 6 t ha^{-1} + 23 kg ha^{-1} N fertilizers (Table 1). On the other hand, the lowest (7.33 gg^{-1}) from 23 kg ha^{-} N fertilizers. The possible reasons for the highest NUE was due to the physicochemical properties of biochar including high surface area and porous structure, high surface functional groups, mineral components (Yao *et al*., 2012; Zheng *et al*., 2013b) which could results in the high adsorbing capacity of the BC and make available the applied N to the plant. In addition, BC has the potential to control the rates of N cycling due to enhancing the soil content of NH_4^+ and NO_3^- through direct adsorption, reducing losses of N leaching

and increased the population of nitrifying soil bacteria for biological N retention (Clough and Condron, 2012).

These results are in agreement with the work of (Chan *et al*., 2008) who reported that that the application of BC with N increases the radish yield. They, indicating that biochar could efficiently improve plant N utilization. Zhang *et al*. (2010) indicated that a BC amendment of 40 t ha^{-1} increased the agronomic N use efficiency from 2.3 kg kg^{-1} with no BC to 5.3 kg kg^{-1} with the BC application (40 t ha^{-1}).

Table 1: Interaction Effects of Biochar and Nitrogen Fertilizer Rate on Total Pod per Plant

Factors		Parameters studied	
Biochar (t ha^{-1})	N fertilizer (kg ha^{-1})	Total pod yield per plant (g)	NUE(g/g)
0	0	24.90^{k}	-
	23	29.73^{j}	7.33^{c}
	46	32.57^{i}	8.76^{cd}
	69	34.57^{h}	8.96^{c}
2	0	33.27^{i}	8.09^{cd}
	23	36.02^{g}	7.71^{c}
	46	39.23^{e}	10.69^{b}
	69	41.50^{d}	12.31^{a}
4	0	35.46^{g}	12.14^{a}
	23	38.67^{e}	9.57^{b}
	46	40.97^{d}	7.36^{d}
	69	43.36^{c}	7.34^{d}
6	0	37.32^{f}	11.96^{a}
	23	48.72^{a}	12.69^{a}
	46	48.33^{a}	11.40^{a}
	69	44.77^{b}	9.80^{b}
LSD (5%)		**1.53**	**1.51**
CV (%)		**1.18**	**2.50**

Means in the column followed by the same letter(s) are not significantly different at 5% level of significance. LSD (0.05) = Least Significant Difference at 5% level; and CV (%) = coefficient of variation in percent; NUE= nitrogen use efficiency.

3.2 Effect of Biochar and Nitrogen Fertilizer Rate on Soil Parameters

3.2.1 Soil pH

Biochar application highly significantly ($P< 0.001$) affects soil pH compared with the control (Appendix Table 1). The highest soil pH (6.01) was resulted from 6 t ha^{-1} alone (Table 2). On the other hand, the lowest soil pH (4.83) was control treatment. The

possible reason for an increase in the pH of the soil was due to high ash content of BC resulted dominated by carbonates of alkali and alkaline earth metals, phosphates and some amounts of organic and inorganic N and due to the rapid proton (H^+) exchange between the soil and the BC. The reduction in exchangeable acidity, exchangeable Al and exchangeable Fe relates to the increase in soil pH because BC has high surface area and contains cations that adsorb the availability of anions (Deal *et al.* (2012).
These results are in agreement with the work of Wang *et al. (*2014) who reported that rice husk biochar increased soil pH by one unit than the control treatment. Martinsen *et al.* (2015) reported that the biochar application to acidic soil caused a significant increase in mean soil pH. In addition Dume *et al.* (2015) reported that biochar application significantly affects soil pH and the highest (6.14) observed from the highest (15 t ha^{-1}) rate of biochar application on acidic soil.

3.2.2 Total Nitrogen (%)

The amount of Total nitrogen in acidic soil was highly significantly ($P<0.001$) affected by main effaces of BC and N and its interaction (Appendix Table 1).The highest total nitrogen (0.34%) was resulted from application of BC rate of 6 t ha^{-1} + 69 N ha^{-1}(Table 2) which is statically similar with total nitrogen obtained from application of BC rate of 6 t ha^{-1} + 46 kg ha^{-1} N. On the other hand, the lowest (0.17%) was recorded from the control treatment. The possible reason for the increased in the amount of total nitrogen in acidic soil with combined application of BC and N could be due some amount of decomposition which might have occurred when BC is added to soil (Liang *et al.,* 2006), which could induce net immobilization of inorganic N already present in the soil solution, high amount of total N present in BC (Tsai *et al.* 2012) and the ability of BC to adsorbed the applied N in the soil (Sohi *et al.,* 2010).
These results are in agreement with the work of Jones *et al.,* (2012) who reported that application of biochar to acidic soil could increase total nitrogen from 0.24 to 0.38 %. Dume *et al*. (2015) reported that the application of coffee husk biochar produced at 500°C temperature and applied at a rate of 15 t ha^{-1} on the acidic soil could increase soil total nitrogen (0.32-0.58 %).

Table 2: Interaction Effects of Biochar and Nitrogen Fertilizer Rate on Total Nitrogen and soil pH

Factors		Parameters studied	
Biochar (t ha^{-1})	N fertilizer (kg ha^{-1})	Total nitrogen %	Soil pH
0	0	0.17^{i}	4.83^{j}
	23	0.21^{fg}	5.44^{fe}
	46	0.20^{fhg}	5.11^{i}
	69	0.19^{ihg}	5.14^{hi}
2	0	0.26^{d}	5.45^{fde}
	23	0.18^{ih}	5.42^{f}
	46	0.19^{ihg}	5.23^{hgi}
	69	0.21^{fg}	5.18^{hgi}

4	0	0.29^{dc}	5.78^{b}
	23	0.24^{e}	5.68^{cb}
	46	0.21^{feg}	5.28^{g}
	69	0.22^{fe}	5.25^{hg}
6	0	0.29^{bc}	6.01^{a}
	23	0.30^{bc}	5.58^{c}
	46	0.32^{ba}	5.57^{cd}
	69	0.34^{a}	5.55^{cde}
LSD (5%)		**0.03**	**0.12**
CV (%)		**6.14**	**1.40**

Means in the column followed by the same letter(s) are not significantly different at 5% level of significance. LSD (0.05) = Least Significant Difference at 5% level; and CV (%) = coefficient of variation in percent.

4. SUMMARY AND CONCLUSION

The results of this study showed that growth, yield, NUE and soil parameters in which green bean was grown total pod yield, NUE, soil pH and total nitrogen increased along with increased application rates of biochar with minimal increased N fertilizer. Accordingly, the main effect of biochar and N fertilizer and its interaction highly significantly influenced total pod yield, NUE, soil pH and total nitrogen. The highest total pod yield (48.72 g) and NUE (12.69 g g^{-1}) were recorded from application of 6 t ha^{-1}BC+ 23 kg ha^{-1} N fertilizer; soil pH (6.01) was from 6 t ha^{-1} BC alone while total N (0.34%) from 6 t ha^{-1}BC+69 kg ha^{-1} N fertilizer.

In conclusion, the results of the present study indicated that the combined application of BC and N fertilizer substantially improved growth, yield, NUE of green bean and some soil chemical properties and accordingly all the combination of BC and N fertilizer levels showed better pod yield and NUE parameters as compared to the control treatment and also application of BC levels showed better soil chemical properties as compared to control and N alone. For instance, maximum total pod yield per plant and NUE were obtained from the combined application of 6 t ha^{-1} BC+ 23 kg ha^{-1} N fertilizer and maximum soil pH were obtained from 6 t ha^{-1} BC on acidic soil under Jimma condition. Therefore, on the basis of the results of the present study, it is indicative that green bean can grow well in the study area and farmers can benefit more by practicing the combined application of 6 t ha^{-1} BC+23 kg ha^{-1} N that resulted in better total pod yield and NUE of green bean and soil pH. However, since the data is obtained from pot experiment, only one season and varieties, it will be worth repeating the experiment under field condition, across different season and locations including various varieties and soil type to draw sound conclusions and recommendations.

Future Recommendations

Similar experiment is suggested to be carried out, especially during the main rainy season under field condition, including different types of biochar with different macro and micro fertilizers, varieties and with different soil type and Agro ecology.

Further studies on different types of organic and inorganic fertilizers with different biochar type for the increment of marketable pod yield, NUE and improvement of soil chemical properties are suggested to be conducted.

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APPENDICES

Appendix Table 1: Mean Squares of ANOVA for Analysis of Variance Showing Mean Squares of Total Pod Yield of Green Bean, **Soil pH and Total Nitrogen**

Source of Variation	DF	TPY	pH	TN

REP	2	0.18 ^{NS}	0.01 ^{NS}	0.01 ^{NS}
BIOCHAR	3	141.65**	0.67**	0.04**
NITROGN	3	255.80**	0.22**	0.01**
BC x N	9	11.79**	0.13**	0.02**
ERROR	30	0.89	0.01	0.02

Where; DF = degrees of freedom; TPY=total pod yield; pH=power of hydrogen; TN =Total nitrogen; ^{NS}, * and ** implies non significant, Significant and highly significance differences at 5% level of probability, respectively.

Appendix Table 2: Mean Squares of ANOVA for Analysis of Variance Showing Mean Squares of Shoot Nitrogen Contents of above ground plant tissue (straw and pod) of Green Bean.

Source of Variation	DF	**Nitrogen content**	
		STRAW	POD
REP	2	0.06*	0.02**
BIOCHAR	3	1.34**	4.01**
NITROGEN	3	0.99**	2.13**
BC x N	9	0.91**	0.95**
ERROR	30	0.04	0.01

Where; DF = degrees of freedom, * and ** implies Significant and highly significant differences at 5% level of probability, respectively.

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STUDY ON THE PREVALENCE OF OVINE GASTROINTESTINAL TRACT NEMATODES IN AND AROUND HAWASSA TOWN, SOUTHERN ETHIOPIA

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ABSTRACT

A cross sectional study from November 2017 to April 2018 was conducted to estimate the prevalence and risk factors associated with major sheep gastro-intestinal tract nematodes in and around Hawassa town of Southern Nation Nationalities and People region, Ethiopia. A total of 384 randomly selected sheep fecal samples were examined using flotation technique. Out of the total sampled sheep, 265(69%) had a gastrointestinal nematode infection. Coprological investigation revealed that sheep in the district were infested by a variety of helminth nematodes. Among nematode eggs Strongyles were most frequently (37.9%) recorded followed by Strongyloides (35.9%) and Trichuris species (11.4%).The study revealed statistically non-significant differences ($p>0.05$) between male and female sheep, even though, higher prevalence was recorded in females. There was also statistically no significant difference ($p>0.05$) between age groups of sheep and study sites. However, a significant difference ($p<0.05$) between body condition of the animals was recorded , with higher prevalence in animals with poor body condition being 1.72 times more exposed to gastrointestinal nematode infection than animals in good body condition with CI (1.08369-2.71624). Gastrointestinal nematodes are one of the major problems that could hamper health and productivity of sheep in the study area. Therefore, emphasis on the control and prevention of GIT nematodes should be given, with further studies on genus and species identification of nematode eggs followed by strong recommendations to tackle the problem in the study area.

Keywords: Hawassa, Gastrointestinal Nematodes, Prevalence, Risk Factors, Ovines

Citation: Sileshi Shilote, Faizullah Peer, Gizachew Fentahun (2019). Study On The Prevalence Of Ovine Gastrointestinal Tract Nematodes In And Around Hawassa Town, Southern Ethiopia. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-2, pp (12-23)

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Received: 20/06/2019

Accepted: 30/07/2019

Published: 29/12/2019

OPEN ACCESS

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1. INTRODUCTION

Sheep and goats are the most populous and closely associated with man among domesticated livestock and are especially, important in more extreme climates of the world. Africa hosts 205 and 174 million sheep and goats, representing 17 and 13 percent of the world's total small ruminant population, respectively. The population of small ruminants in sub-Saharan Africa is estimated to be 274 million (Samson and Frehiwot, 2010). Ethiopia is believed to have the largest livestock population in Africa (Tilahun and Schmidt, 2012) and (CSA, 2013).

Naturally endowed with different agro-ecological zones and suitable environmental conditions, the country is a home for many livestock species and suitable for livestock production. An estimate indicates that the country is home for about 54 million cattle, 25.5 million sheep and 24.06 million goats. With these figures the country is the second in Africa, and sixth in the world, in terms of sheep population (CSA, 2013).

Sheep and goats are of great importance as major sources of livelihood and contribute to the sustenance of landless, smallholder and marginal farmers especially, to the poor in the rural areas throughout the developing countries. Studies have revealed that ruminants contribute 80% of the total food production from livestock in tropical Africa, of which small ruminants account for about 22%. Sheep and goats are very important for poor-resource smallholder systems of rural Ethiopia, due to their ease of management, short generation cycles and high reproductive rates which lead to high production efficiency and significant role in providing food and generation of cash income. They serve as a living bank for many farmers, closely linked to the social and cultural life of poor-resourced farmers and provide security in bad crop years (Tsedeke, 2007).

Globally parasitic diseases continue to be a major constraint especially, for poor developing countries. Most of the losses that come from the parasites are shared by the gastro-intestinal helminthes. Therefore, helminth infections in small ruminants pose serious problems in the developing world particularly, where nutrition and sanitation are poor (Thrusfield, 2005).

Besides, gastro-intestinal nematode infection is also a major health problem in the world. Furthermore, these nematode infections affect the health of millions of people and animals, causing huge economic loss in livestock farming (Souls, 1982). In addition, nematode parasites are also a major problem for small ruminants. In these animals, a range of nematode infection present as a mixed infection that mainly invade the small intestine and abomasum of small ruminants. This group of parasites includes; Haemonchus, Cooperia, Ostertagia, Bunostomum, Trichostrongylus, Oesophagostomum and Nematodirus (Abebe and Esayas, 2001).

Small-holders and pastoralists may not easily detect the effect of helminthes because of the subclinical nature of the infections (Souls by, 1986) and (Urquhart *et al.*,1996). Thus, the sub-clinical nematode infections are responsible for significant economic losses. They are responsible for immune-suppression and enhancing the

susceptibility of the animals to other diseases. Prior to the detection of clinical diseases, economic losses in terms of animal productivity are already in place. (Kaplan, 2006). In Ethiopia production losses due to helminth parasites are often substantial amounting to a loss of 81.8 million US$ annually (Demelash *et al.*,2006).
In the developed world, the greatest component of impact by these nematode parasites is probably the involvement of the cost for control measures. But their impact is greater in the sub-Saharan Africa in general and Ethiopia is particular due to ecological factors suitable for diversified hosts and parasite species (Ragassa *et al.*, 2006). The epidemiology of gastro-intestinal (GIT) parasites in livestock varies depending on the local climatic conditions, such as humidity, temperature, rainfall, vegetation and management practices (Takelye, 1991). These factors largely determine the incidence and severity of various parasitic diseases in different regions of the country. Thus, in the study area gastrointestinal nematode infection is one of the major constraints for small ruminant's production, however, data on the distribution of the parasite in this area are lacking. So that knowing the current situation of GI nematode in the area could be the basis for all possible actions including its control and eradication. Therefore, this study was conducted to determine the prevalence of major gastrointestinal nematodes of sheep in Hawassa district and to assess the potential risk factors associated with ovine gastrointestinal nematode infection in the study area and to generate base line data for further studies.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

A cross sectional study was conducted from November 2017 to April 2018 in Hawassa town of the Southern Nation Nationalities and People region, to determine the prevalence of major gastrointestinal nematode parasites in small ruminants in Hawassa district. Hawassa is the capital of Sidama zone administration and Southern Nations Nationalities and Peoples' Regional State (SNNPRS) as well. It is located in the northern part of SNNPRS, 275 km South of Addis Ababa. It geographically lies between 4º27′and 8º30′ N latitude and 34º21′and 39º1′ E Longitude at an altitude of 1,790 m above sea level. The area receives an average annual rain fall ranging from 800 to 1,000 mm of which 67% falls in the long rainy season, extending from June to September. During the study period, the mean minimum and maximum temperatures of the area were 20.1ºC and 30ºC, respectively, and 51.8% mean relative humidity. The area is mainly covered by dry savannah and bush type vegetation (NMA, 2008). The total livestock population of Sidama zone (including Hawassa) is estimated at 1,721,341 cattle, 228,941 goats, 457,465 sheep, 57,643 horses, 54,066 donkeys, 725,540 poultry, and 44,492 beehives (CSA, 2008).Based on the 2007 census conducted by the CSA, this zone has a total human population of 2,954,136, of whom 1,491,248 are men and 1,462,888 women, with an area of 6, 538.17 square kilometers (CSA, 2007).

2.2 Study Animals

All the study animals were indigenous breeds, kept under traditional extensive and semi intensive management system. Conventionally, those animals with the age of less than one year were considered as young while those greater than or equal to one year were included as adults according to the classification of age groups by (Kumssa *et al*., 2011). Body condition scoring of sampled animal was carried out according to the method described by (Cooper and Thomas, 1985) and categorized into three scores as poor, medium and good. The poor body condition was recorded when individual spinous processes were sharp to touch and easily distinguished, in addition, the bony structure of the sheep was easily noticeable. The eye muscles had moderate depth. Medium body condition was recorded when the spinous processes examined with very firm pressure were round rather than sharp. The eye muscle areas were full with moderate fat cover. Good body condition was recorded when the top and side of the back bone in loin area immediately behind the last rib and above the kidney were covered with muscles. The eye muscles were full and had a thick fat cover.

2.3. Study design

A cross sectional study was conducted from November, 2017 to April, 2018 to determine the prevalence of gastro-intestinal nematode parasites in sheep based on carpological examination of nematode eggs.

2.4. Sampling Method and Sample Size

Simple random sampling technique was employed to select the required number of the study population. Prior to sampling, each selected animal was given an identification number and data on each animal's sex, age, breed and origin was recorded. Age, sex, species and body condition were considered as risk factors for the occurrence of major gastrointestinal nematodes in sheep in and around hawassa town Southern Ethiopia. Since there was no such research work conducted in the study area, expected prevalence of 50% was assumed to get the maximum number of sample size required. The total sample size was calculated based on the pre-determination of the following parameters: 50% expected prevalence, 5% absolute precision and 95% confidence interval. The formula used to calculate the sample size is shown below,

$$N = \frac{(1.96)^2 \, Pexp \, (1-Pexp)}{d^2} \qquad \{Equ.1\}$$

Where: Pexp = expected prevalence (50%)
P = prevalence
N = required sample size
d = desired absolute precision
Since there have been no previous reports on the prevalence of GIT ovine nematodes in the study area, the prevalence of 50% and 5% absolute precision at a 95% confidence

interval (CI) was considered. Accordingly, 384 sheep were sampled and examined for GIT nematodes.

2.5 Sample Collection and Examination Procedure

Fresh faecal samples were collected directly from the rectum of selected animals and the samples were placed in labeled separate screw capped bottles. During sampling, age, sex, and body condition was recorded through observation. Finally, the collected samples were kept in a cool box until it reached Hawassa University Veterinary Laboratory for coprological investigation. The majority of samples were processed on the same day of sample collection. Samples not examined immediately after the arrival at laboratory were stored at +4°C and examined early in the morning on the next day. The collected faecal specimens were processed and examined by direct faecal floatation technique for qualitative investigation of the various types of gastro-intestinal nematode eggs following the standard procedure indicated by Urquhart *et al.* (Urquhart *et al*., 1996). Sodium chloride (NaCl) was used as floatation solution.

2.6. Data Management and Analysis

The collected data was coded into appropriate variables and entered into MS excel worksheet. All statistical analysis was performed using statistical data packages for social science (SPSS) version 20. The prevalence was calculated by dividing the number of positive animals by the total number of animals examined and times 100. Percentage (%) to measure prevalence and Chi-square ($\chi 2$) was used to test the existence of differences in prevalence between age groups, sex, body condition scores and site of collection. In all the analyses, confidence level was held at 95% and $P<0.05$ was set for significance.

3. RESULTS AND DISCUSSION

The gastrointestinal nematodes of sheep are one of the most important parasitic diseases that obviously resulted in reduced productivity of sheep raised by small-holders using traditional husbandry management systems in and around Hawassa district.

From a total 384 sheep examined, 265 (69.0 %) were infected with different types of gastro-intestinal nematodes. Among total positive cases, 74 (37.9%) were infected with strongyles, 70(35.9%) with Strongyloides spp, 23 (11.8%), with Trichuris species and 28(14.4%) had mixed type. Strongyle and Trichuris species were commonly encountered as mixed infections followed by Strongyle and Strongyloides. The predominant GIT nematodes identified in sheep in the study area were strongyles, strongyloides, mixed type and Trichuris species (Table 1).

The coprological examination done for this study using direct faecal floatation method, revealed an overall gastrointestinal infection prevalence of 69.0% of sheep originating from this area which were being parasitized at least by one type of gastrointestinal nematodes. However, an apparent difference was noted. The present findings to some extent agree with previous studies on coprological examination in

some areas of Ethiopia including in and around Asella (68.1%) by (Diriba and Birhanu, 2013), Eastern Hararghe Zone (64.6 %) by (Abdurezak *et al*., 2015) and in Pakistan (62.8%) by (Ahmad *et al*., 2012). However, higher rate of prevalence contrary to the results in previous surveys in sheep in some areas of Ethiopia, such as Gondar Town, Northwest Ethiopia (37.7%) by (Meaza *et al*.,2012) and Pakistan (49.47%) by (Hamdullah *et al*., 2013) has been recorded.

Morever, the findings of previous surveys in sheep do not corroborate with our results showing higher prevalence in some areas of Ethiopia ; 98.9% Southern Ethiopia by (Amenu, 2005), 76.3% Welinchity by (Moti, 2008), 86.9% Debre Ziet by (Gonfa *et al*., 2013), and 74.56% Serbia by (Kulisic *et al*., 2013) from abroad. The possible explanation of this difference could be due to difference in agro-climatic conditions that could support prolonged survival and development of infective larval stage of most nematodes (Getachew *et al*., 2017). Furthermore, management system of animals and sample size could also contribute to the differences of the prevalence rates (Regassa *et al*., 2006).

Table1: The prevalence of particular ovine gastrointestinal nematode infection.

Nematode egg type	No.of animal examined	No of positive	Prevalence (%)
Strongyle	384	74	37.9%
Strongloides	384	70	35.9%
Trichuris	384	23	11.8%
Mixed	384	28	14.4%
Total	384	265	69%

From the total sheep population examined in the four sites of origin, samples from dato (27%) showed higher prevalence and samples from chaffe showed lower infection prevalence (22.6%). The chi-square ($\chi 2$) test value indicated that there was no statistically significant difference ($P > 0.05$) in prevalence of gastro-intestinal nematode infection of sheep between the four sites(Table 2). In the present study there is no statistical significant difference ($P< 0.05$) between the different study sites and corroborate with (Lemma and Abera, 2013) and (Armour, 1980) where no significant difference in animals reared in similar geographical areas was reported. This similarity might be due to the similar nature of management systems of examined animals, geographical and environmental location of the area having same agro-ecology. Meanwhile, effects of different agro-ecology and geographic areas showing significant difference in the prevalence of nematode infection rate (Demelash *et al*., 2006) has been recorded.

Table2: Prevalence of major gastrointestinal nematode in different sites of study area using coprological examination.

Site of origin	No of animal examined	No of animal infected	Chi square (p-value)
Tulla	96	70(26.4%)	
Chaffe	98	60(22.6%)	

Dato	96	67(27.7%)	3.978 (0.264)
Tikurwuha	94	68(25.7%)	
Total	384	265(69%)	

Females and males were found to be infested with a prevalence of 60.4% and 39.6%, respectively, but there was no statistically significant variation (P>0.05) between the two sexes (Table 3). Young and Adult animals were found to be infested with a prevalence of 60.8% and 39.2% respectively, with no statistically significant difference (p>0.05) (Table 3). Infection prevalence was significantly higher in animals with poor body condition as compared to that of medium and good body condition scores (P < 0.05) and animals being poor in body condition were 1.72 times more exposed to infection than in good body condition with CI (1.08369-2.71624). The overall infection prevalence according to body condition grades recorded was, 43%, 30.9% and 26% with poor, medium and good, respectively (Table 3).

In this study, no significant variations were observed between males and females despite higher infection noticed in female sheep. This finding is in agreement with that of (Diriba and Birhanu, 2013) in Asella, (Abdurezak *et al*., 2015) in Eastern Hararghe Zone, (Dagnachew *et al*., 2011) in North Gondar and (Hamdullah *et al*., 2013) in Pakistan. Yet, contradicting other reports including (Tesfalem, 2016) in Meskan district, Gurage zone, (Regassa *et al*., 2006) in Western wolega, and (Raza, *et al*., 2007) in southern Punjab abroad. It is assumed that sex is a determinant factor influencing prevalence of parasitism and females are more prone to parasitism during pregnancy and per-parturient period due to stress and decreased immune status (Keyyu *et al*.,2003; Regassa *et al*.,2006).

Table3: Prevalence of ovine gastrointestinal nematodes by sex, age, body condition.

Risk factor	No. of animal examined	Positive (%)	Prevalence (%)	Chi-square(p-value)	
Sex					
Male	151	105	39.6	0.032(0.885)	
Female	233	160	60.4		
Body condition					OR (95% CI) 1.72(1.08369-2.71624)
Good	131	69	26	30.369(0.000)	
Medium	117	82	30.9		
Poor	136	114	43		
Age					
Young	234	161	60.8	0.012(0.913)	
Adult	150	104	39.2		

From gastrointestinal nematode egg types encountered in the study area, Tulla recorded higher prevalence in Strongloides spp. (34%) and lower prevalence in trichures spp. (18.9%), from Chaffe higher prevalence was recorded in trichures spp. (32.4%) and lower prevalence was recorded in Strongloides spp. (18.4%), from Dato higher prevalence was recorded in trichures spp. (32.6%) and lower prevalence was recorded in Mixed type spp. (16.7%) and from Tikur wuha higher prevalence was recorded in strongyle spp. (36%) and lower prevalence was recorded in trichures spp. (16.2%) (Table 4). The chi-square ($\chi 2$) test value indicated that there was no statistically significant difference ($P > 0.05$) in prevalence of gastro-intestinal nematode egg type infection of sheep between the four sites (Table 4).

Table 4: Prevalence of gastrointestinal nematodes egg type encountered in the study area.

Origin	No.of animal positive	Strongyle	Strongloides	trichures	Mixed type	Chi-square (P-value)
Tulla	70	18(20.2%)	35(34%)	8(18.9%)	9(25%)	20.699 (0.14)
Chaffe	60	25(27%)	20(18.4%)	13(32.4%)	12(27.8%)	
Dato	67	16(16.9%)	30(30.1%)	14(32.6%)	7(16.7%)	
Tikurwuha	68	32(36%)	18(17.5%)	7(16.2%)	11(30.6%)	

From the gastrointestinal nematodes, egg types encountered sex-wise, males showed higher prevalence of Strongloides spp. (38%) and lower prevalence in Trichuris spp. (11.1%) and in females higher prevalence was recorded in Strongloides spp. (38.9%) with lower prevalence in Trichuris spp. (14%). But there was statistically no significant difference ($P > 0.05$) in prevalence of gastro-intestinal nematode egg type infection of sheep between sexes. From the gastrointestinal nematodes egg types encountered in age-groups, young ovine's recorded higher prevalence in Strongloides spp. (40.9%) and lower prevalence in mixed type spp. (11%) and in adults higher prevalence was recorded in Strongloides spp. (36%) with lower prevalence in Trichuris spp. (13.5%). But there was no statistically significant difference ($P > 0.05$) in prevalence of gastro-intestinal nematode egg type infection of sheep between age groups. Egg type encountered in the poor body condition of ovine higher prevalence was recorded in strongyle spp. (39.4%) and lower prevalence was recorded in mixed type spp. (8.7%), in medium higher prevalence was recorded in strongloides spp. (39.3%) and lower prevalence was recorded in mixed type spp. (19%) and in good body condition higher prevalence was recorded in strongloides spp. (46.8%) and lower prevalence was recorded in Trichuris spp. (11.7%). But there was no statistically significant difference ($P > 0.05$) in prevalence of gastro-intestinal nematode egg type infection of sheep in different body condition grades (Table5).

In the current study young sheep were more frequently infected than adult sheep. But there was no statically significant difference ($P > 0.05$) between the two age groups. This finding has concurrence with (Abdurezak *et al*., 2015) in Eastern Hararghe Zone,

(Hamdullah *et al*., 2013) in Pakistan and (Diriba and Birhanu, 2013) in Asella. On the contrary, this observstion is in disagreement with the findings of (Dagnachew *et al*.,2011) in North Gondar who recorded higher prevalence in adults, (Tesfalem, 2016) in Meskan district, Gurage zone, and (Kulisic *et al*.,2013)in Serbia from abroad who reported equal chances of exposure for both the age groups. The possible reason for this finding might be that new born and younger sheep lack strong immunity than the adults. The possible explanation is that in adult sheep, after primary infection, rapid solid immunity is acquired. In fact, sheep continually exposed to infection are at low risk provided the rate of acquisition of infective larvae is sufficient to stimulate satisfactory response, and no cause of clinical illness (Diriba and Birhanu, 2013).

There are also special conditions encountered during peri-parturient rise in nematode eggs excretion, as early as two weeks before lambing, and persisted up to eight weeks post-partum after lambing, and occurs mostly during the wet seasons. Thus, pregnant or lactating ewes became the major source of infections for the newborn lambs (Ng'ang'a *et al*., 2006).

In this study, a significant difference was observed in prevalence of nematode infection in relation to body condition score, where a higher prevalence of gastrointestinal nematodes parasites was recorded in poor and moderate body condition as compared to the animals with good body condition and it was statistically significant ($p<0.05$). This finding has coherence with (Vanwyk *et al*., 2006; Negasi *et al*., 2012; Gonfa *et al*.,2013; Radostits *et al*.,2006; Odoi *et al*., 2007; Knox *et al*.,2006). however , these results contradict with (Tesfalem, 2016) and (Jejaw *et al*.,2014), with a possible reason for higher prevalence in poor animals of the host species because comparatively, weaker immune system in these animals to fight with the infections than that of a healthy animal's immune system (Kuchai *et al*., 2011).

Table5: Prevalence of ovine gastrointestinal nematodes egg type encountered in sex, age and body condition

Variables	No. Of animal positive	Strongyle	strongloides	trichuris	Mixed type	Chi-square (p-value)
Sex						
Male	105	39(37.1%)	40(38.9%)	12(11.1%)	14(13%)	1.760(0.624)
Female	160	49(31.2%)	62(38.9%)	26(15.9%)	23(14%)	
Age						
Young	161	54(33.8%)	63(40.9%)	25(14.3%)	19(11%)	2.179(0.536)
Adult	104	36(33.3%)	38(36%)	12(13.5%)	18(17.1%)	
Body condition						
Good	69	21(27.3%)	33(46.8%)	6(11.7%)	9(14.3%)	11.549(0.073)
Medium	82	27(32.1%)	32(39.3%)	8(9.5%)	15(19%)	
Poor	114	43(39.4%)	37(32.7%)	23(19.2%)	11(8.7%)	

4. CONCLUSION

Gastrointestinal nematodes are the major animal health constraints in sheep production contributing to the loss in productivity and economy. The present study results indicated that gastrointestinal nematodes lead to major helminthosis of sheep in and around Hawassa district, with an overall prevalence of 69%. The high prevalence of GIT nematode parasites of sheep thus recorded is indicative of the abundance and importance of the disease in the study area and its potential contribution in limiting the productivity of sheep. This study was based solely on coproscopic examination for detection of gastrointestinal nematode eggs. The results have provided an insight to the current prevalence rate and associated risk factors. Age, sex and body condition were potential risk factors associated with prevalence of gastrointestinal nematode infection in the study area. But only body condition significantly influenced the prevalence of the infection. These variations need to be taken into account while devising control and prophylactic strategies for GIT infection of sheep.

A strategic anthelminthic treatment of sheep with broad spectrum anthelminthics at the beginning of rainy season and at the end of dry season to reduce the worm burden and minimize larval pasture contamination, good managemental practices, rotational grazing system for different seasons, separating the most susceptible animals especially pregnant and lactating ewes from flocks, support of veterinarians and animal health extension workers in giving professional advice regarding preventive and control measures against gastrointestinal helminth parasites in the area is highly desirable.

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ACKNOWLEDGEMENTS

Authors are thankful to Dean College of Veterinary Medicine and Head, Department of Veterinary Medicine Samara University and Hawassa University authorities and veterinary laboratory assistants, and all others concerned for their kind help and cooperation during the study.

DIJBAR
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Volume-1 Issue-2

Critical Analysis on Frequency of Amharic Sounds: the perspective of corpus Linguistics

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ABSTRACT

Corpus linguistics basically give more emphasis to collocation, frequency and corpus statistics. This study intends to investigate the frequency of Sounds in Amharic, to explore the unique linguistic features found in Amharic, and to assess the nature and characteristics of Amharic fields. Critical research paradigm was used in this study. To achieve the objectives of the study the researcher used elicitation and documents analysis as data gathering method. To briefly summarize the findings of the study, in terms of sound articulations the characteristics of all consonants in Amharic is the same except ሀ /ha/. In Amharic lexicons the frequency of the sixth sound or sadıs fidels is very high. More explicitly, in most basic or core vocabularies of Amharic the sixth or sadıs fidels are occur frequently 68.75 % in average. This indicate that, the frequency of the sixth sound or sadıs fidel in Amharic language is very high especially in basic or core vocabularies. The distribution of the sixth sound or sadıs fidel is might be at the first syllable or the last syllable. Therefore its distribution is not common. In other words, the sadıs sound may come at the beginning of word or middle of word or end of a lexicons. Orthographically speaking, single fidel or consonant can convey full text or message. For example: ና /na/ 'come', ያ /ja/ 'that'this can be considerd as the unique feature of the target language. In Amharic, it is very tough to get the sixth fidel followed by the long vowel. Therefore, in lexicon creativity and productivity linguists should consider the sixth fidel to create the non-existing lexicon in Amharic.

Keywords: Corpus, fidel, Frequency, Amharic

Citation: Samuel Leykun (2019). Critical Analysis on Frequency of Amharic Sounds: the perspective of corpus Linguistics.Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-2, pp (24-37)

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Received: 27/06/2019

Accepted: 30/08/2019

Published: 29/12/2019

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1. INTRODUCTION

Amharic is among the standard and dominant languages spoken in Ethiopia. It also used as a linguafrance in different area of the country. According to Girma (2010), there are two hypotheses on the origin of Amharic: it may be a descendent of a common Proto-Ethiosemitic language or it may have evolved as a Semitic-based pidgin, which became a creole and eventually developed into a full-fledged language. While the first hypothesis is commonly accepted in Semitic Studies, the second hypothesis, first proposed in the beginning of the 1980s, became quite popular very recently and even entered Amharic textbooks. In addition, he notes that the arguments that seem to suppose the origin of Amharic as a pidgin. Based on chronological, historical, geographical, and linguistic grounds, Girma clearly demonstrates that the pidgin hypothesis is blatantly implausible. Not only the linguistic data on Amharic provide strong arguments against the pidgin hypothesis but also the relationship between Amharic and the remaining Ethiosemitic languages in general, and Argobba in particular, do not support it.

According to (Hannah 2015:183-84) all consonants except the glottal stop can surface as either singleton or geminate. Geminates are quite common in Amharic and can be either lexical or grammatical. Some words lexically contain a geminate, but many grammatical processes result in geminates even when the roots themselves do not contain lexical geminates.

The other point intouch with (Hannah 2015:184) is that, if a syllable ending in a geminate precedes a syllable beginning with a consonant, the second half of the geminate must either join as a phonotactically well-formed onset with the following consonant (obeying the sonority hierarchy), or a vowel must be epenthesized between the geminate and the following consonant separating the two halves of the geminate into distinct syllables.

Armbruster (2010) on his part states that, Amharic is the language most widely spoken and written in Abyssinia at the present day. It is indigenous not only in Amhara, the region from which the name is taken, but over the greater part of Central Abyssinia. As a language of commerce it is heard beyond the limits of Abyssinia proper.

In Amharic verbs are derived from roots. The conversion of a root to a basic verb stem requires both intercalation and affixation. For instance, from the root gdl 'kill', it is possible to obtain the perfective verb stem gäddäl- by intercalating pattern ä_ä. From this perfective stem, it is possible to derive a passive (tägäddäl-) and a causative stem (asgäddäl-) using prefixes tä- and as-, respectively. Verbs are inflected for person, gender, number, aspect, tense and mood (Baye, 2000). Other elements like negative markers also inflect verbs in Amharic.

Amharic is among the morphologically rich languages. Some adverbs can be derived from adjectives. Nouns are derived from other basic nouns, adjectives, stems, roots, and the infinitive form of a verb by affixation and intercalation. Case, number, definiteness, and gender marker affixes inflect nouns. Adjectives are derived from nouns, stems or verbal roots by adding a prefix or a suffix. Moreover, adjectives can

also be formed through compounding. Like nouns, adjectives are inflected for gender, number, and case (Baye, 2000).

Corpus linguistics is a newly emerging sub-disciplines of linguistics. Nothing has been done before on Amharic corpus linguistics perspectives. That is why the researcher motivated.

Objectives of the study

The study has the following major objectives:

i. To investigate the sound frequency in Amharic lexicons,
ii. To explore the unique linguistic features found in Amharic, and
iii. To assess the nature and characteristics of Amharic fidels.

Conceptual framework: Corpus Linguistics

The term corpus is derived from the Latin word *corpus* that means "body". The Latin term, however, displays two distinct descendants in modern English:

a. *Corpse* (it means via Old French *Cors*) and
b. *Corps (it came via modern French corps in the 18th centurary*

Within the domain of modern corpus linguistics, the term 'corpus' refers to "a large collection of linguistic data, either written texts or a transcription of recorded speech which can be used as a starting point of linguistic description or as a means of verifying hypotheses about a language" (Crystal 1995). Thus, it refers to a large collection of written and spoken text samples, available in machine-readable form, accumulated in scientific manner to present a particular variety or use of a language.

A corpus is designed for accurate study of the linguistic properties, features, and phenomena observed in a language. Moreover, in corpus, quantity and quality refers to a large amount of language data and authenticity respectively.

What is Corpus linguistics?

Corpus linguistics is a relatively new field of language research and application. It evolved as one of the most promising empirical fields of language study that contributed in a handsome manner for multidimensional growth of mainstream linguistics and language technology in general.

Corpus linguistics, as an important area of computational linguistics, plays a pivotal role. It provides large quantities of empirical language databases accumulated in a systematic manner from various fields of actual language use following some statistical methods and techniques of data sampling. Also it provides some sophisticated devices to analyse these corpora to extract linguistic data, examples, and information necessary in applied linguistics, computational linguistics, and artificial intelligence for understanding human languages in a better way as well as for applying this data and information in various fields of human knowledge.

Basic Terminology

N: Sample / corpus size, number of tokens in a sample

V: vocabulary size, number of distinct types in a sample

V_m: spectrum element m, numbner of types in the sample with frequency m (i.e. exactly m occurences)

V_1: number of hapax legomena, types that occur only once in the sample (for hapaxes, #types= #tokens)
Consider (caabccacd) N=9, V=4, V_1=2

Rank/frequency profile:	item	frequency	rank
	c	4	1
	a	3	2
	b	1	3
	d	1	3 (or 4)

Expresses type frequency as fucntion of rank of a type

Zipf's law
For word level frequency possible to use zipf's law.

- Straight line in double-logarithmic space corresponds to power lawfor original variables.
- This leads to Zipf's (1949, 1965) famous law:

$$f(w) = \frac{C}{r(w)^a} \text{ or } f(w) \alpha \frac{1}{r(w)}$$

f(w): frequency of word w

r(w): ranks of the frequency of word w (most frequent= 1,....)

with a = 1 and c = 60,000 Zipf's law predicts that:

- most frequent word occurs 60,000 times
- second most frequent word occurs 30,000 times
- third most frrequent word occurs 20,000 times
- and there is a long tail of 80,000 words with frequencies
- between 1.5 and 0.5 occurances (!)

2. MATERIALS AND METHODS

Any scientific research requires methodology and data gathering instruments. The figure represented below shows the methodology and the tools to be used in this study. Figure1 outline clearly shows the skeleton of research methodology utilized in this research. More explicitly, the frame of the outline of the research methodology contains: natural language, sources of the data, primary sources, (interview with two priests and two Deacons), secondary sources, (document analysis). The aforementioned sources were the genuine data sources of frequency in Amharic: from corpus linguistics perspective. The researcher believed that, this methodology can help linguists to extract the data about general overview of critical analysis of frequency in Amharic: perspective of Corpus linguistics from real stakeholders.

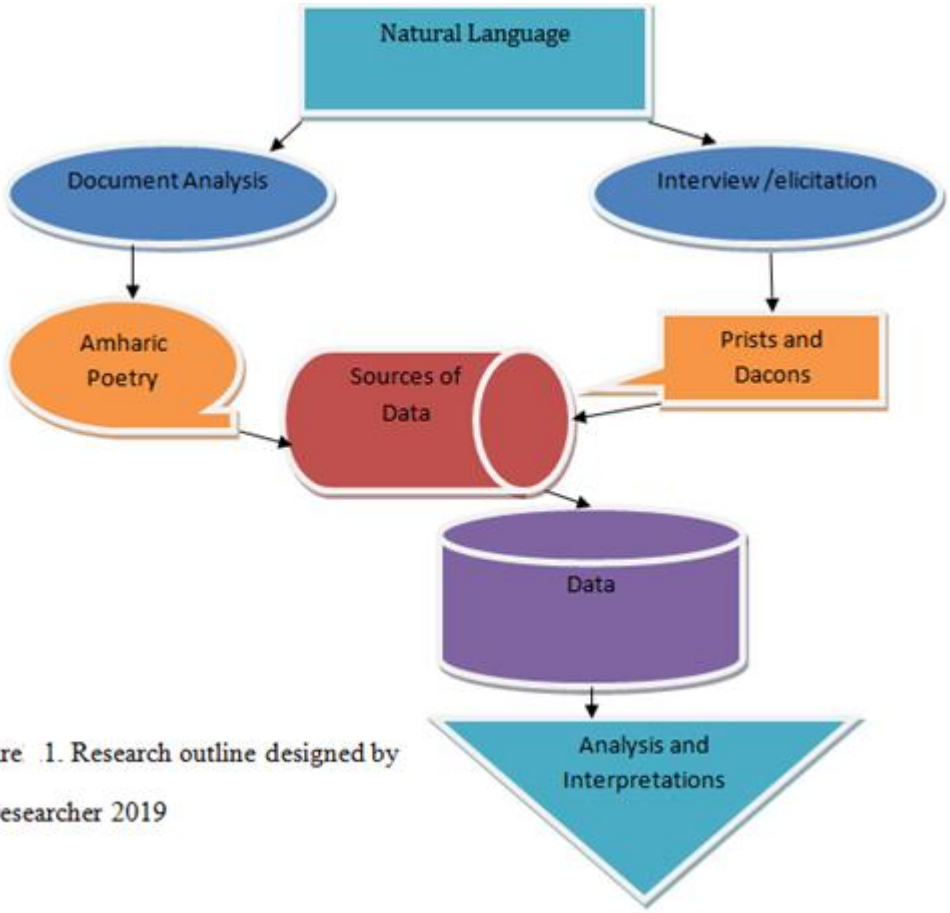


Figure 1. Research outline designed by the researcher 2019

3. RESULTS AND DISCUSSION

Data Obtained from Interview

The researcher collected the data from an interviewee to achieve the objectives of the study. Accordingly, the priests of different Ethiopian Orthodox Church form Gonder West *Belesa* and Gojjaam *Meddaa* are considered.

The result of the data collected from the informants on the characteristics of sounds in Amharic *Fide presented* as follows:

In Amharic each *fidel* has seven characters. For example (1). , ሀ /ha/, ሁ /hu/, ሂ /hi/, ሃ /ha/, ሄ /he/, ህ hɪ/, and ሆ /ho/. Like most langauges of the world consonants in Amharic are followed by vowels while articulation. For example (2) , ለ = l + ä = /lä/, ሉ = l + u = /lu/, ሊ = l + i = /li/, ላ = l + a = /la/, ሌ = l + e = /le/, ል = l + ɪ = /lɪ/, and ሎ = l + o = /lo/

In Amharic all consonants have same characters except ሀ /ha/ or ሐ /ha/ or ኀ /ha/. For example (3), ሀ = h + a = /ha/, ሁ = h + u = /hu/, ሂ = h + i = /hi/, ሃ = h + a = /ha/, ሄ = h + e = /he/, ህ = h + ɪ = / hɪ/, and ሆ = h + o = /ho/

On the above example (2) the consonant /l-/ is followed by vowel /-ä/. This character works for all Amharic consonants. Whereas, on the example (3) the consonant /h-/ followed by vowel /-a/.

In Amharic the following consonants have same function.

Table 1. Homophonic consonants in Amharic

Consonants (in Orthographic)	Phonemic	Place of Articulation	Manner of Articulation
ሀ or ሐ or ኀ	/ha/	Glottal	Fricative
ሰ or ሠ	/sä/	Alveolar	Fricative
ጸ or ፀ	/s'ä/	Alveolar	Fricative

The data collected from the other informant shows that, the characteristics and features of *fidels* of Amharic and its relation with Ge'ez from differen perspective. More explicitly, in Ahmaric langauge the above fidels represent the same phoneme and have same functions. Therefore, it is possible to use the cosonants alternatively. However, in Ge'ez the fidels have different fuctions and impossible to use alternatively. Even the place and manner of articulation of the ሀ or ሐ or ኀ, ሰ or ሠ፣ አ or ዐ፣ ጸ or ፀ are not the same. See the following examples: ሀ - Glottal, fricative, ሀለዌ /haläwä/ 'live', ሐ - Pharyngeal, Fricative ሐሞረ /hamär/ 'ship', ኀ - Velar, Fricative ኀዘነ /xazänä/ 'sorrow', and ሰ - Alveolar Fricative ሰብእ /

All Amharic consonants are followed by /-ä/ vowel except ሀ or ሐ or ኀ /ha/ (see appendix A). Moreover, in Amharic, at the beginning of the lexicons or vocabularies the frequency of the consonant ሀ or ሐ or ኀ /h-/ shows that, unlike other consonants always followed by the vowel /-a/. The rest of Amharic consonants are followed by the

vowel /-ä/. For example (4) ሀገር /hagär/ ‘country’ ሀይል /hajıl/ ‘power’ ሀይማኖት /hajımanot/ ‘religion’ impossible to get indigenous[1] Amharic lexicon that start with /hä/. In contrary, for ለ /lä/ or in the rest consonants possible to find Amharic lexicons that start with /la/ and /lä/ for example (5): ላም /lam/ ‘cow’ ላይ /lajı/ ‘up sters’ and ለዉጥ /läwut’ı/ ‘change’ ለምለም /lämılämı/ ‘fertility’
The other reason is that the nature or characteristics of fidels in the target language is consonant + vowels. See the following fugue2.

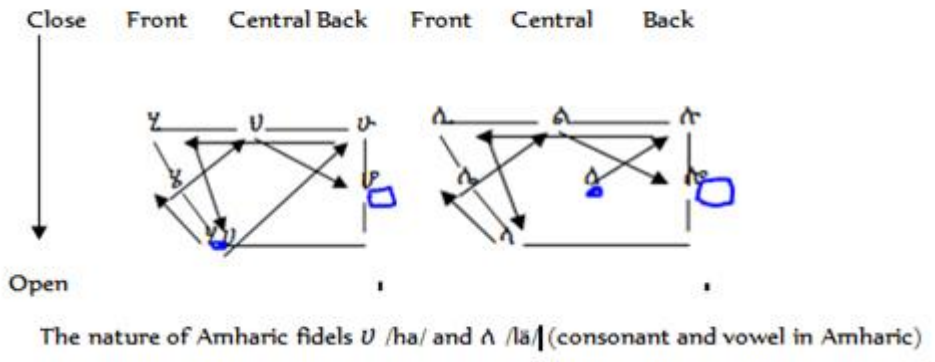


Figure 2: The Nature of Amharic

This is vowel chart of Amharic, and the characters of Amharic fidels are determined by vowels. Because there are seven vowels in Amharic, each fidel in Amharic has seven characters.
The above figure shows that, most Amharic *fidels* have seven characters. More explicitly, the characteristics of ሀ /ha/ is different from that of ለ /lä/. However, in Amharic both consonants are known as the first consonant in Ge’ez known as Ge’ez which means the first. In fact Amharic and Ge’ez have a lot features in common. In other there is a possibility for /-a/ vowel to be long vowel /aa/. However, no such possibility for central vowels /-ä/. Therefore, the *fidel* ሀ /ha/ prefer the vowel /a/ unlike other consonants in Amharic. As indicated in the above figure the characteristics of all consonants in Amharic is the same except ሀ /ha/.

Unique features of Amharic

The other informant explained the unique characteristics and features of fidel of Amharic and its relation with chants of Ethiopian Orthodox Church. Orthographically speaking in Amharic a single fidel or consonant can convey full text or message. Some example (6) are as follows: ና /na/ ‘come’, ያ /ja/ ‘that’, ፐ /pä/ amazing’, ማ? /ma/ ‘who’, and ዋ /wa/ ‘notice’

[1] Not borrow words

Chants of Orthodox Church and its relation with the characteristics of *Fidel*

As indicated above Ge'ez and Amharic share different features.

1. ***Araray*:** a type of chant that is used in ዋዜማ ቀለማት /wazema k'älämatı/. In such type of chant there are full of stresses at the beginning of the words and the last phone or sound is very long. Most of the time such chant used the 2nd, 4th and 7th f*idels*. For example (7), ሁ /hu/ ሉ /lu/ ማ /ma/ ሳ /sa/ ሆ /ho/ and ቶ /to/.
2. ***Ezel*:** is another type of chant which associates with periods of fastining and sorrow and exclussive for holly week. Compared to with that of *Araray, Ezel* type of chant does not used long vowel at the end of the words in the chant. Such Chant used the 3rd and 5th characters of *fidels* at the end of the word in the chant. For example (8): ሂ /hi/ ሚ /mi/ ሴ / se/ and ቴ /te/.
3. ***Ge'ez*:** the last type of chant. Used short vowels at the end of the word in the chant. Used 1st and 6th *fidel* character in the chant. For example (9): መ /mä/ ተ /tä/ ረ /rä/ ም /mɪ / ር /rɪ / and ት /tɪ /.

In *Araray* and E*zel* type of chant almost in all words, the last vowel is long. However, in Ge'ez type of chant in all words the last vowel is central one. In Amharic the central vowel is short. Therefore, the central and short vowel is the common characteristics of most Amharic *fidel*. That is why most Amharic fidel are followed by the central vowel /-ä/. On the other hand, the characterstics of the first fidel in Amharic or ሀ /ha/ is more of Araray which is very rare in the target langauge.

Reading styles of Amharic and Ge'ez

The othe iformant explained that the characteristics and features of fidel in Amharic its relation to Ge'ez reading style as follows:

In Ge'ez there are three major styles during reading. These are:

1. ወርድ /wärɪd/: during this all fidels are read very slowly and there is a gap between each fidels and words.
2. ቁመ /k'umɪ/: read very fastely. It is a very rapid type of reading.
3. ቁጥር (ማዕዝ) /k'ut'ɪr or /gɪʔɪz/: during reading, enumerate each fidels. It is less like ወርድ /wärɪd/.

The four kinds of reading

1. ተነሽ /tänäʃ/: The words are read with high pitch or high sound. Read with a very high tone. These reading occurs in five characters of letters (*fidels*). These are 1st, (Ge'ez), 2nd (kaɪb), 3rd (salɪs), 4th (rabɪ), and 7th (sabɪ) at the end of the word. Example ሖረ /horä/ 'go' ጽምኡ /s'ɪmɪʔu/
2. ተጣይ /tät'aɪ/: Read words with very slow sound or no high pitch. It shed the words. It occours only at 6th /sadɪs/ *fidels* or letters. Example ማርያም /marɪjam/ 'name of person' or Jesus's Mam' አዳም /ʔadam/ 'adem' እኩይ /ʔɪkuɪ/ 'bad'

3. ስያፍ /säjaf/: This type of reading is the same with that of ተነሽ /tänäʃ/. But, it occours only in the 6th /sadıs/ *fidel* or letter. For exanple (10) የሀዉር ምድረ ከንዓን /jähawur mıdırä känäʔan/ 'go to the land of Kenean' ይሰሙይ አማኑኤል /jısämäı ʔamanuʔel/ 'the name of Amanuel'
4. ወዳቂ /wädak'i/: Is the same as that of the 2nd types, but it occours in all characters of the *fidels* (i.e., read by the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th). For example (11), አሀተ /ʔatä/ '1st', ስለስቱ /sılätu/ '3rd', ሙሴ/mäse/ 'name of person', ዝ /zı/ 'this', ሙና /mäna/ 'food', ገባሪ /gäbari/ 'performer or worker, ከበሮ /käbäro/ 'drum'

The above data shows that, words are read with high pitch or low pitch based on the kinds of reading style. In addition, in most kinds of reading styles the consonants are followed by the central vowels. Moreover, in some words there are similarities of sounds word finally.

Consider the Amharic basic vocabulary እግዚሃብሄር N=7, V=4, V_1=3

Rank / frequency profile:

item	frequency	rank
እግብር or *sadıs*	4	*1*
ዚ or *salıs*	*1*	*2*
ሃ or *rabı*	*1*	*2 (or 3)*
ሄ or *hamıs*	*1*	*2 (or 4)*

The above table shows that, the frequency of the 6th *fidels* (እግብር) are 4 with the first rank. Whereas, the frequency of the 3rd (ዚ), 4th (ሃ), and 5th fidel (ሄ) are 1 with the second, third and fourth rank respectively. Being asked to list basic vocabularies in Amharic, the informants have elicited the following vocabularies.

Table 2: Look at the Amharic basic vocabularies

Basic vocabularies	Phonemic transcription	The sixth or sadıs fidels in the vocabulary	Total number of the sixth or sadıs fidels in the basic vocabulary (frequency in number)	Total number of the fidels in the basic vocabulary	Frequency in %
እግዚሃብሄር	/ʔıgızihabıher/	እ፤ ግ፤ ብ፤ ፤ር	4	7	57.1
ምግብ	/mıgıb/	ም፤ ግ፤ ብ	3	3	100
እርሻ	ʔırıʃa/	እ፤ ር	2	3	66.67
ልጅ	/lıʤ/	ል፤ ጅ	2	2	100
አጥብያ	ʔat'ıbija/	ጥ፤ብ ፤ያ	3	4	75
እልፍኝ	/ʔılıfıɲ/	እ፤ ል፤ ፍ፤ኝ	4	4	100
ከብት	/käbıt/	ብ፤ት	2	3	66.67
ወንዝ	/wänız/	ን፤ዝ	2	3	66.67
ቤተክርስቲያን	/betäkırıtijan/	ክ፤ር፤ስ፤ን	4	8	50

አዝእርት	/ʔazrʔırıt/	ዝ፤እ፤ር፤ት	4	5	80
ሳር	/sar/	ር	1	2	50
ጥሬ	/t'ıre/	ጥ	1	2	50
ብስል	/bısıl/	ብ፤ስ፤ል	3	3	100
ክምር	/kımır/	ክ፤ም፤ር	3	3	100
ቡና	/bun:a/	-	-	-	0
ቅጠል	/k'ıt'l/	ቅ፤ል	2	3	66.67
ምድጃ	/mıdıʤa/	ም፤ድ	2	3	66.67
ሰላም	/sımı/	ም	1	3	33.34
ፀሎት	/s'älot/	ት	1	3	33.34
ክፍያ	/kıfaj/	ክ፤ፍ	2	3	66.67
ቤት	/bet/	ት	1	2	50
ደጅ	/däʤ/	ጅ	1	2	50
እሰይ	/ʔısäj/	እ፤ይ	2	3	66.67
ምሽት	/mıʃıt/	ም፤ሽ፤ት	3	3	100
ንጋት	/nıgat/	ን፤ት	2	3	66.67
Total			**55**	80	68.75

The above table reveals that, out of 80 fidels of Amharic found in the above basic vocabularies, 55 (68.75%) are the sixth or *sadıs fidels* in the target langauge. In addition, the above table shows that, the frequency of the sixth or *sadıs fidels* is very high. In most basic vocabularies of Amharic the sixth or *sadıs sounds* occured frequently 68.75 % in average. This indicates that, the frequency of the sixth consonant or *sadıs fidel* in Amharic language is very high.

Data obtained from Document Analysis

This part presented the document analysis of the study. In this part the researcher assessed the documents such as: - Holly Bible, newspapers, and other books written in Amharic.

In Amharic lexicons can be represented in to three tiers, the three tiers being the consonantal tier, also called the root tier, the skeletal tier and the vocalic melody tier.

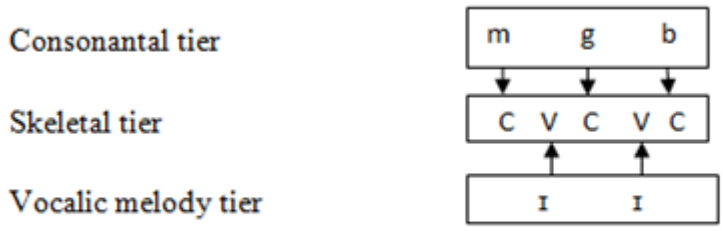


Figure 3 CV-based formation of the Amharic basic vocabulary ምግብ /mıgıb/

The above figure 3 shows that in the Amharic's noun ምግብ /mıgıb/ 'food' all consonants are sadıs or the sixth consonant. In addition, the vowels indicated on the vocalic melody tier are central vowels.

The meaning of a noun is signaled at the root-tier by the consonantal segments. Usually a noun has three consonants in its underived lexical entry in the lexicon. Thus the root /m-g-b/ in Amharic represents the lexeme food, which is realized by a variety of noun forms.

The skeletal tier provides a canonical shape that is associated with a particular meaning or grammatical function. The template C 1V1C2V2C3 , for example, carries the grammatical meaning perfective.

The vocalic melody tier provides information analogous to that carried in English by inflectional affixes like tense, aspect, number or derivational affixes. For example, in the above Amharic /mıgıb/ the vocalic pattern /ı-ı/ indicates that these central vowels prompted the frequency of the sixth or *sadıs fidels* are very high in Amharic.

In most Amharic texts, the 6th letter or Amharic 6th fidel occurred frequently. As mentioned above the data collected from different secondary sources shows that *sadıs* or the 6th occurred frequently in Amharic texts. In other words the frequency of the 6th or *sadıs fidel is very high* in Amharic as compared t o the first fidel /gıʔız/, the second /kabıʔı/, the third /salıs/, fourth /rabıʔı/, fifth /hamıs/, and the seventh /sabıʔı/. Because, the linguistic feature of the sixth fidel or *sadıs* is followed by the central short vowel /-ı/. On the other hand in Amharic other consonants took the long vowels.

The first *fidels* /gıʔız/ followed by /-ä:/, the second fidel /kabıʔı/ followed by /-u:/, the third fidel /salıs/ followed by /-i:/, the fourth fidel /rabıʔı/ followed by /-a:/, the fifth fidel /hamıs/ followed by /-e:/, the sixth fidel /saıs/ followed by /-ı/, and the seventh fidel /sabıʔı/ followed by /-o:/.

In Amharic lexicon structure, it is very tough to get the sixth fidel followed by the long vowel. Therefore, consonant plus vowel (C+V) the short vowel or consonant plus short vowel frequently occurred in Amharic. The distribution of the sixth *or sadıs* fidel in Amharic is not common. In other words the *sadıs* fidel may come at the beginning or middle or end of a word. See the following examples (12),

ይድረስ ለወንድሜ ለማላዉቅህ [jıdıräs läwändıme lämalawk'ıh]

"..... ማነህ ባክህ ወንድምዬ [manäh bakıh wändımıje]

አገዎ ነህ ወይስ ሺናሻ [ʔagäwo näh wäjıs ʃınaʃa]

ቅማንቴ ነህ ወይስ ፈላሻ [k'manıte: näh wäjıs älaʃa]

ስምህ የሆነብኝ ግርሻ....." [sımıh jähonäbıň gırıʃa]

ሎሬት ፀጋዬ ገብረመድን 1964 ዓ.ም [loretı s'ägaje gäbırädıhın]

The above poem is taken from Laureate Tsegaye Gebremedhin's book entitle እሳት ወይ አበባ /ʔısat wäj ʔabäba/ 'either fire or water'. In the poem there are 17 words and 60 fidels. Let see the characteristics of all fidels in the poem in the following table3.

Table 3: The fidels in the poem

List of words from the poem	Phonemic transcription	The sixth or sadıs fidels in the poem	Total number of the sixth or sadıs fidels in the poem (frequency in number)	Total number of the fidels in the poem	Frequency in %
ይድረስ	/jıdıräs/	ይ፤ድ፤ስ	3	4	75
ለወንድሜ	/wändıme/	ን፤ድ	2	5	40
ለማላዉቅህ	/lämalawuk'ıh/	ቅ፤ህ	2	6	33.34
ማነህ	/manäh/	ህ	1	3	33.34
ባክህ	/bakıh/	ክ፤ህ	2	3	66.67
ወንድምዬ	/wändımıje/	ን፤ድ፤ም	3	5	60
አገዎ	/ʔagäwo/	-	-	-	-
ነህ	/näh/	ህ	1	2	50
ወይስ	/wäjıs/	ይ፤ስ	2	4	50
ሺናሻ	/ʃinaʃa/	-	-	-	-
ቅማንቴ	/k'ımanıte/	ቅ፤ን	2	4	50
ነህ	/näh/	ህ	1	2	50
ፈላሻ	/fälaʃa/	-	-	-	-
ወይስ	/wäjıs/	ይ፤ስ	2	3	66.67
ስምህ	/sımıh/	ስ፤ም፤ህ	3	3	100
የሆነብኝ	/jahonäbın/	ብ፤ኝ	2	5	40
ግርሻ	/gırıʃa/	ግ፤ር	2	3	66.67
Total			**28**	**52**	53.84

The word አገዎ, /ʔagäwo/ 'Agew community', ፈላሻ, /fälaʃa/ 'Falasha' and ሺናሻ /ʃinaʃa/ 'Shinasha community' etymologicaly not belong to Amharic that is why the frequency result shows 0. The above table shows that, out of the total 52 Amharic fidels 28 (53.84%) of these fidels are the sixth or sadıs fidels in the poem. Excluding the above three words, the average result of the sixth *fidel* or *sadıs* shows 53.84%. This explicitly indicates that the frequency of the sixth *fidel* or *sadıs* in Amharic poem is very high.

4. CONCLUSION

In Amharic all consonants have same characters except ሀ /ha/. In the words እግዚሃብሄር the frequency of the 6th *fidels* (እግብር) are 4 with the first rank. Whereas, the frequency of the 3rd (ዚ), 4th (ሃ), and 5th fidel (ሄ) are 1 with the second, third and fourth rank respectively. In the Amharic's noun ምግብ /mıgıb/ 'food' all fidels are sadıs or the sixth sound. In addition, the vowels indicated on the vocalic melody tier are central high vowels.

Among the basic vocabularies of Amharic the frequency of the following lexical items are 100% the sixth or *sadıs fidels* in the target language እልፍኝ /ʔɪfɪɲ/ ብስል /bɪsɪl/ ክምር /mɪkɪr/ ምግብ /mɪgɪb/ ልጅ /lɪʤ/ ምሽት /mɪʃɪt/. Therefore the frequency of sadıs fidels is very high in Amharic. Therefore, linguists ought to consider in lexical creativity for the words not found in the target language. In amharic lexical items can be represented in to three tiers, the three tiers being the consonantal tier, also called the root tier, the skeletal tier and the vocalic melody tier.

In most Amharic the first *fidels* /gɪʔɪz/ is followed by /-ä:/, the second fidel /kabɪʔɪ/ is followed by /-u:/, the third fidel /salɪs/ followed by /-i:/, the fourth fidel /rabɪʔɪ/ followed by /-a:/, the fifth fidel /hamɪs/ followed by /-e:/, the sixth fidel /saɪs/ followed by /-ɪ/, and the seventh fidel /sabɪʔɪ/ followed by /-o:/. In Amharic lexical item the distribution of the sixth *or sadıs* fidel is not common. In other words the *sadıs* fidel may come at the beginning or middle or end of a word.

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Appendix A

List of Amharic Fidels and Phonemic Transcription

No.	Amharic Fidels	Phonemic Transcription	No.	Amharic Fidels	Phonemic Transcription	No.	Amharic Fidels	Phonemic Transcription
1	ሀ	/ha/	17	ከ	/kä/	23	የ	/jä/
2	ለ	/lä/	18	ኸ	/hä/	24	ደ	/dä/
3	ሐ	/ha/	19	ወ	/wä/	25	ጀ	/ʤä/
4	መ	/mä/	20	ዐ	/a/	26	ገ	/gä/
5	ሠ	/sä/	21	ዘ	/zä/	27	ጠ	/t’ä/
6	ረ	/rä/	22	ዠ	/ χ ä/	28	ጨ	/čä/
7	ሰ	/Sä/	12	ቸ	/ʧä/	29	ጰ	/p’ä/
8	ሸ	/ʃä/	13	ኀ	/ha/	30	ጸ	/s’ä/
9	ቀ	/k’ä/	14	ነ	/nä/	31	ፀ	/s’ä/
10	በ	/bä/	15	ኘ	/ɲä/	32	ፈ	/fä/
11	ተ	/tä/	16	አ	/a/	33	ፐ	/pä/

Appendix B

List of participants of the study.

Name	Age	Districs	Churches	Remark
Yibabe	35	West Belesa	St. Michael	Informant
Mahitot	38	West Belesa	St. Michael	Informant
Aimiro Siyoum	60	West Belesa	St. Michael	Informant
Meseret Aimiro	21	West Belesa	St. Michael	Enoumerator
Merigeta Henok	38	Meddaa	Meddaa St. Michael	Informant
Yegebo Aseffa	21	Meddaa	Meddaa St. Michael	Enoumerator

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Volume-1 Issue-2

Software piracy understanding, challenges, detection and prevention in higher education students of Ethiopia

Abdulahi Mahammed Adem[1]

ABSTRACT

Software piracy is the unauthorized copying and distribution of software (Lee, 1994). According to Ping and Chang (2004), piracy is the unauthorized usage, transfer, copying and reproduction of copyrighted software. Piracy entails the violation of license agreements and transpires when you install, download, file share, issue or copy digitized data such as entertainment media and software programs with no consent from the owner or inventor. As software is getting more valuable, unauthorized users or malicious programmers illegally copies and distributes copyrighted software over online service provider (OSP) and P2P networks. Digital piracy as a continuing problem significantly impacts various stakeholders, including consumers, enterprises, and countries. The aim of this study is to understand student motives and drivers of piracy and provide insights into the ways individuals rationalize their behavior in regards to digital piracy. The increase of piracy has, of late, greatly affected the market for software applications (Andres, 2006). According to the International Planning Research Corporation (IPRC), the estimated world piracy rate for business software applications alone was 39% in 2002, leading to losses of $13.07 billion (IPRC, 2003). According to the first annual Business Software Alliance (BSA) & International Data Corporation (IDC) study in 2004, for every two dollars' worth of software purchased legitimately, one dollar's worth was obtained illegally.

Keywords: Software Piracy, Piracy detection, Piracy prevention

Citation: Abdulahi Mahammed Adem (2019). Software piracy understanding, challenges, detection and prevention in higher education students of Ethiopia. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-2, pp (38-46)

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Received: 22/11/2019

Accepted: 10/12/2019

Published: 29/12/2019

OPEN ACCESS

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1. INTRODUCTION

The widespread incidence of unauthorized use and copying of computer software has had a devastating impact on the software industry in recent years. Significantly costly time and effort is invested by software programmers in developing a program and with software piracy preventing these developers from recouping remuneration from users, the incentives existing to produce new software may not be sufficient enough for any further development, causing the industry to stagnate. This would be costly to not only computer programmers but also to the government who would miss out on a significant amount of taxation revenue and society as a whole, whose software choices would be diminished. The attitudes that students have regarding software piracy have been the subject of several studies. Christoph, Forcht and Bilbrey (1987) found that prior computer experience made no significant difference in their attitudes toward piracy. Cohen and Cornwell (1989a) replicated the study by Christoph et. al. and added additional questions asking respondents whether they themselves had engaged in software piracy and whether they consider it legal. Husted (2000) determined that several factors that comprise national culture influence the probability that someone will engage in software piracy; these factors includes level of economic development, income equity and cultural sense of individualism

The purpose of this study was to better understand and identify software piracy behaviors. The study begins with a discussion on software piracy followed by an overview of a survey conducted among students. The study mainly aims to answer the following questions.

1. What are the types of software piracy?
2. What are the key factors encouraging software piracy?
4. What measures can be taken to reduce software piracy?

Software piracy

Software is defined as a set of instructions which when incorporated in a machine readable form or in capable of causing a computer to perform a particular task. To put it simply, it is a series of commands which can be understood by the machine. There are three essential types of software which help to function the computer, micro code which is a program which controls the details of execution, the operating system software which controls the sources of a computer and manages routine tasks and which is a necessary requirement for a computer to function; application software which is designed to perform a particular task.

Piracy occurs when copyrighted software is made available to users to download without the express permission of the copyright owner. Such illegal software is offered over online sources such as online advertisements newsgroups bulletin board service and auction sites. Piracy hampers creativity, hinders the development of new software and local software industry and ultimately effects e-commerce. Piracy harms

consumers and has negative impact on local and national economy. Consumers run the risk of viruses and having corrupted and defective programs.

Software piracy is the unauthorized copying and distribution of software (Lee, 1994). Piracy takes place when individuals or groups of people make illegal copies of software with the intension of selling it for a profit. When someone installs a software application on a local area network (LAN) server, where employees can gain unlicensed access, that person makes him/herself guilty of committing corporate piracy. Reseller piracy, involves computer hardware, where companies sell computers with illegal copies of software preloaded onto their hard drives. Home piracy ranges from the distribution of illegal software, by trading disks with friends, family and colleagues, to running non-profit bulletin boards for distributing illegal software. Publisher patent and copyright infringement involve intellectual property theft, where one person copies material from another, without obtaining permission or acknowledging that they plan to profit from such action.

History of software piracy

Software Copyright Act of 1980, software was not recognized as intellectual property, so there were no laws against theft or reproduction. When the Computer Software Copyright Act was implemented, software was defined as "literary work," thereby making programmers the equivalent of modern day literary authors. So, digital piracy is much younger. When personal computers first came on the public market in the late 70s, the notion of what role software would play was very different from what it is today. In late 1989, the U.S Patent Office began to issue patents to software developers, giving birth to the notion that all digital media is the intellectual property of the author; therefore, the author owned the rights to the compiled program and the underlying source code. Software piracy's origins are very innocent in nature. Before pirated material became hot property, before the widespread use of the Internet, and even before laptops and CDs, there were computer geeks. Computer geeks are universal and are the forefathers of software piracy. Piracy began in the 1980s when computer technology was still new. Computer software was either for extreme hobbyists or large corporations. The few computer geeks lucky enough to have their own computers at home were few and far between. Computer geeks loved their computers and were proud to own such a marvelous piece of technology. Owning a computer meant you had the ability to solve complex mathematical equations at home, or run one of some 20 available commercial software packages at any time. Computer geeks flocked to local universities, which held monthly computer clubs where computer geeks met to share ideas and talk about their computers. At this point in time, few very people even knew what a computer was, let alone held a conversation about one, so, meeting another computer geek was a real treat. These computer clubs offered a way for club members to share the software that they had written with other members. Some of the first games ever developed were first shown off in computer clubs. It was in the social computer club environment that piracy first appeared. Although computer geeks had already invested a substantial amount of money in their home computers, most computer owners were not wealthy.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The survey approach was used to investigate trends in software piracy. A survey was conducted on members of 285(two hundred eighty five) students of college of engineering and technology, which are taken from each department of the college. A questionnaire was prepared and distributed to some of the students of CET, of samara university, Ethiopia. The first part of the questionnaire captured the demographics of the participants who participated in the survey. The demographics section collected details about individuals' age, gender, income, education and whether they own computers. The second part of the questionnaire focused on the reasons for using pirated software, the tasks performed using pirated software and participants' consumer behavior. It also focused on their knowledge of software piracy, e.g. whether they could spot the difference between original software and illegal software, whether they were aware that their computers might have illegal software loaded onto them and also focusing on the easiest ways to obtain illegal software. A letter was included with the questionnaire explaining to participants what the questionnaire is about. The letter mentioned that the results would only be used for research purposes and that they would be treated confidentially. This ensured that participants would not shy away from participation.

2.2 Research questions

Even though a number of studies have investigated software piracy among students in several countries, little information is available about why and what proportion of the computing students in a South East Asian country like Brunei Darussalam, use pirated software. It is also not clear whether the factors as identified by past studies are applicable to explain software piracy among Bruneian students. It is because Brunei Darussalam is culturally very different from Europe, US and Hong Kong. Against this backdrop, this study was initiated to address the following research questions:

1. What proportion of computing students use pirated software?
2. What are the tasks that computing students perform with pirated software?
3. What are the reasons for using pirated software by computing students?
4. What are the factors that are related to computing students' use of pirated software?

3. RESULT AND DISCUSSION

3.1 Gender based usage of pirated software

Eighty eight percent (88%) of the population sample falls into the age group of between 18 and 23 years. Of this specified group, 55 per cent are illegal software users, 25 per cent are legitimate users and 20 per cent are unsure if they have illegal software on their computers.

TABLE 1 PROFILE OF PARTICIPANTS

Profile of participants	%
Gender	
Male	63.14
Female	36.86
Age	
18 years and younger	11.76
Between 18 and 23 years	88.24
23 years and older	0.00
Income	
200Birr or less	61.90
Between 200Birr-500Birr	23.81
Between 500Birr-1000Birr	9.52
More than 1000Birr	4.76
Education	
Education of any type in computer	100.00
No education of any type in computer	0.00
Computer ownership	
Own a computer	95.24
Does not own a computer	4.76
Pirated software	
Bought pirated software	98.95
Has not bought pirated software	1.05
Probability pirated software can fail	48%
Difference between illegal and original software	
Can spot difference	42.86
Cannot spot difference	57.14

TABLE 2 SURVEY OF PARTICIPANTS

	Percentage		
Age	**Legal**	**Illegal**	**Not sure**
18 years and younger	-	100.00	-
Between 18 and 23 years	5.00	79.00	11.00
23 years and older	-		-
Gender			
Male	4.5	86.77	8.73
Female	12	74.84	13.16
Income			
200Birr or less	3.18	93.5	3.32
Between 200Birr and 500Birr	10.00	80.00	10.00
Spot difference			
Can recognize difference	13.33	75.56	11.11
Cannot recognize difference	16	68.65	15.35
Believe that pirated software can fail	69.05	44.00	58.00
Past purchase behaviour			
Bought pirated software before	-	75.00	25.00
Haven't bought pirated software	19.41	62.94	17.65
No education in IT	50.00	50.00	-
Computer owner ship			
Own a computer	3.81	77.14	19.05
Do not own a computer	-	-	-
Education			
Education in IT	7.69	61.54	30.77
No education in IT	50.00		50.00 -

3.2 Income based usage of pirated software

According to the original results, 62 per cent of the population sample have a monthly income of 200Birr or less, 24 per cent have an income between 200Birr-R500Birr, 10 per cent between 500Birr -R1000Birr and 5 per cent earn more than 1000Birr (Table 1). It was decided to normalize income groups by removing the income group, "Between 500Birr - R1000Birr" and "More than R1000Birr" from the analysis for statistical purposes, because only two persons and one person, respectively, made up each category. This created two categories for the purposes of analysis. Of the normalized income group that earns 200Birr or less, 23 per cent are legitimate users, 54 per cent are illegitimate and 23 per cent are not sure whether they have pirated software on their computers. Of the income group that earns more than 2000Birr, 40 per cent are legitimate users, 40 per cent illegitimate users and 20 per cent are not sure whether they have illegal software on their computers. There appears to be a weak relationship between an individual's income and his/her use of pirated software (the correlation was measured as 50 per cent). There was a probability of 90 per cent that a person earning a low salary will use pirated software.

3.3 Computer Ownership Based Usage of Pirated Software

The results showed that just one person in the sample did not own a personal computer. According to the sample group, of those that own a computer, 4 per cent are legal users, 77 per cent are illegal users and 19 per cent are not sure whether they have illegal software on their computer (Table 2). It can be stated that there is a relationship between computer ownership and the use of pirated software. The probability that computer owners will use illegal software is nearly 96 per cent.

A person who owns a computer is likely to spend more time on a computer (Rahim *et al.*, 2000). Such a person will perform a wider variety of tasks than someone that does not own a computer. To obtain a wider variety of software, the person is likely to obtain software from various sources, some of which could be illegal software. It can be argued that there is also little or no supervision on the use of software when people are working in their own privacy. This could in turn encourage the use of pirated software. The theory is thus supported by the findings.

3.4 Education Based Usage of Pirated Software

Since the study is held at Higher Education College of engineering and technology, the results show that 100 per cent of the population sample had some form of IT education and 0 per cent no IT education (Table 1). Of the 100 per cent of computer literates in the sample, about 7 per cent are legal users of software, 62 per cent are illegal users of software, while 31 per cent of them are not sure whether they make use of pirated software. The results show that IT educated people make greater use of illegal software.

Tan (2002) *cites* Solomon and O'Brien, who note that educational background, amongst other demographics of consumers, is significantly correlated with their

attitude towards software piracy (Tan, 2002). People who have limited experience with computers are likely to perform routine tasks only and are unlikely to try a wider variety of software programmes (Rahim *et al.*, 2000). People who have more experience with computers have greater knowledge of software use. The frequency and duration of software use of these people will increase and therefore they will be more likely to use a wider variety of software. Computer-experienced people are more likely to use pirated software. The results in this study therefore support the theory, but not that significantly.

4. RESEARCH FINDINGS

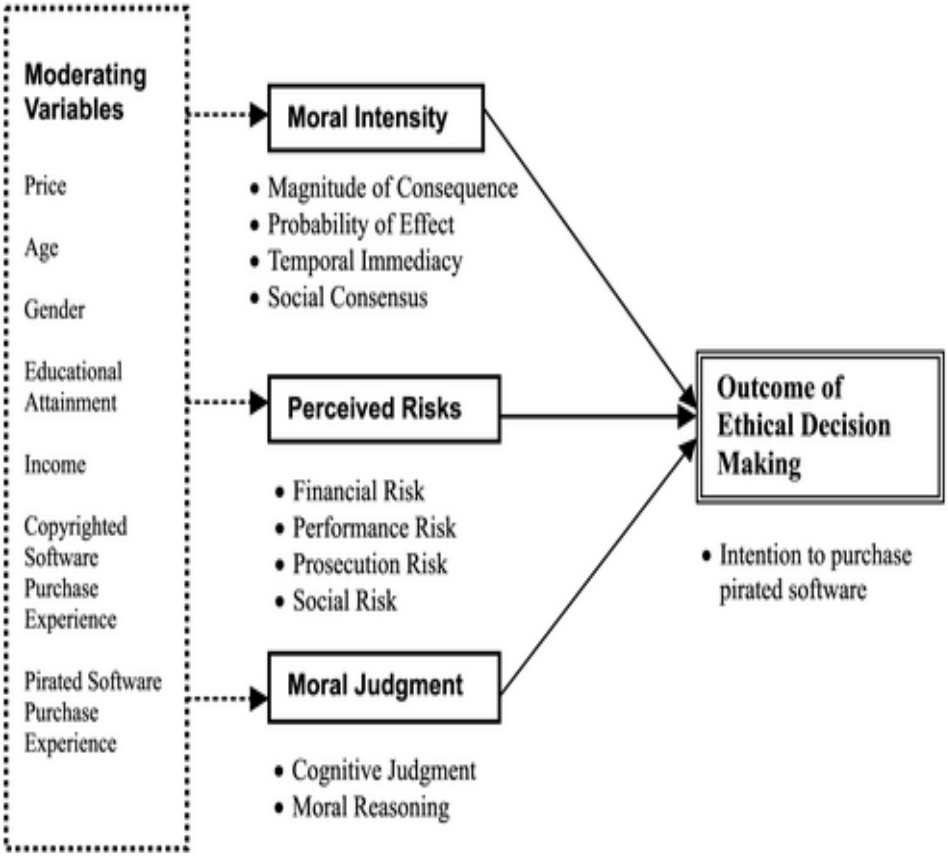
Students are likely to continue consuming pirated materials, even when they aware of their adverse effects on the economy, and links to organized crime. Consumption patterns for pirated products were not homogeneous. Different consumer profiles had different decision-making processes. Influencing factors included age, purchasing power, education and the perceptions of the environment.

Price was not a fundamental variable; it was only relevant to a group of consumers in certain contexts. Physical pirated products were mainly bought in flea markets and open markets. While pirated products might be marketed through all sales channels, they were less likely to penetrate highly centralized value chains and sales channels such as department stores, because of more rigorous quality controls.

The Internet and the rise of social networks have been crucial to the consumption of digital piracy in Ethiopia.

When the surveyed participants were presented with examples of illegal or unethical activities, they considered them all to be worse than piracy, including activities such as telling lies or stealing a loaf of bread or a sweet. This suggests that there is a fairly widespread social acceptance of piracy, even though most people know that it is illegal. The phrase "*it's illegal, but not serious*" probably best sums up the attitude towards piracy in Ethiopia. Also, the study also detected two reasons for illegal acts: they were believed to have **no consequences** or they were **not considered serious**. It is also important to mention the endogenous component in the answers about the reasons for consuming pirated products.

FIGURE 1: RESEARCH FINDINGS



5. CONCLUSION

Software piracy is the one of the serious issue in Ethiopia among students. Knowingly or unknowingly they are committing cybercrime. Following preventive measurements and recommendations can be used to stop the software piracy among students.

Preventive measures

This section focuses on several efforts that have been made to reduce worldwide software piracy. The following are some of the measures.

i. Understanding proper use of software and the law
ii. Increasing public awareness and education
iii. Open Source Software

6. RECOMMENDATION

i. Consumers are particularly receptive to deterrent messages that emphasize the **negative effects and risks** that consuming pirated products imposes on individual wellbeing, especially concerning health and safety risks.

ii. Consumers are also receptive to messages that make the connection between the sale of counterfeit or pirated products and the activities of **organized crime.**

iii. **Avoid oversimplifying the phenomenon** of piracy. It is a multifaceted problem of serious dimensions.

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BIOSORPTION OF CONGO RED FROM AQUEOUS SOLUTIONS USING *CLEODENDRUM FRAGRANS LEAVES*: KINETIC AND THERMODYNAMIC STUDIES

Ravi Kumar Madugula[1*] King Pulipati[2], AytenewGetaye[3], EliasBarsenga[4] and DejenMandefro[4]

ABSTRACT

The aim of the present study is to remove Congo red (CR) dye from their aqueous solution using *Cleodendrum fragrans* leaves powder as biosorbent in a batch study. The variables covered in a batch study were contact time, solution pH, initial CR dye concentration, biosorbent dosage, average particle size of the biosorbent and temperature. The kinetic and isotherm studies of biosorption of CR dyes onto *Cleodendrum fragrans* biosorbent was investigated using various kinetic pseudo first order, pseudo-second order and isotherm models (Langmuir, Freundlich, Temkin). The experimental data of biosorption of the dye onto the *Cleodendrum fragrans* biosorbent fitted well with the Langmuir isotherm model. The isotherm reveals that the biosorption of the dye onto *Cleodendrum fragrans* biosorbent was favourable. Thermodynamic parameters such as Gibbs free energy, enthalpy change and entropy change were also estimated for the biosorption of CR dye. The thermodynamic studies indicated that the biosorption of Congo red dye onto *Cleodendrum fragrans* biosorbent was spontaneous, feasible and endothermic.

Keywords: Congo red, *Cleodendrum fragrans*, pollution control, aqueous solution, Biosorption.

Citation: Ravi Kumar Madugula, King Pulipati, AytenewGetaye, EliasBarsenga and DejenMandefro (2019). Biosorption Of Congo Red From Aqueous Solutions Using *Cleodendrum Fragrans Leaves*: Kinetic And Themodynamic Studies. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-2, pp (47- 60)

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Received: 11/11/2019

Accepted: 20/12/2019

Published: 29/12/2019

OPEN ACCESS

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1. INTRODUCTION

Fresh water is a limited resource in many parts of the world. And this will become more dearth's due to increasing in population, urbanization and climate change. The major fact for this paucity of fresh water is not only due to demand for water but also due to pollution in fresh water ecosystem. 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 source 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. It contrast, non-point pollution results from storm runoff, which transports polluting materials diffusely over land. Color in the liquid effluents can also decrease the capacity of plants in photosynthesis. Uses of different kinds of shampoos by human beings are major threat to the water and now a day they act as water pollutants **[1]**. There are more than 10,000 commercially available dyes with over 7 lakh times of dyestuff being produced annually across the world **[2].** 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 as follows **[3].** Biosorption technique was most favorable procedure among all the physico-chemical and adsorption, flocculation combined with flotation, membrane filtration, electro kinetic 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 mixie. 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. Chemicals

The other chemicals used in the present study were NaOH and HCl. The pH of solutions is adjusted with 0.1 N HCl and 0.1 N NaOH. The entire chemicals used were analytical reagent (AR).

2.4. Batch mode biosorption studies

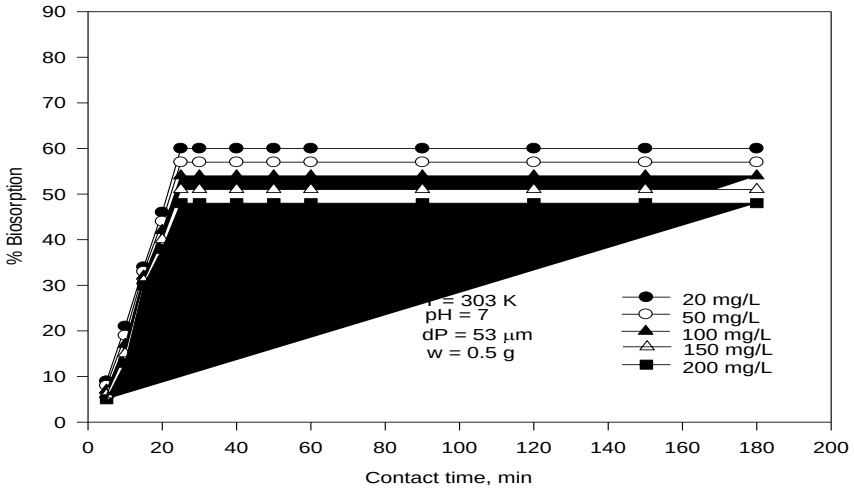
Batch biosorption equilibrium experiments were conducted in 250 ml conical flasks at a constant agitation speed (180 rpm). All the experiments were carried out at room temperature (± 30^0C). The concentrations of both the dyes before and after sorption were determined using UV- Vis spectrophotometer by monitoring the absorbance for the dye used.

3. RESULTS AND DISCUSSION

3.1. Effect of contact time

The percentage of biosorption was determined at different contact times and the results are shown in Fig1. The figure reveal that the percentage of biosorption Congo red was steeply increased with an increase in contact time from 5 to 25 min and there after reached plateu after attaining equilibrium 25 min for Congo red. Therefore, contact time of 25 min is sufficient for the removal of Congo red under the experimental conditions used in this study. The percentage of biosorption of *Cleodendrum fragrans* leaves as biosorbent for Congo red dye removal was increased from 9 to 60 %, with an increase in contact time from 5 to 25 min for an initial dye concentration of 20 mg/L. For 200 mg/L, the percentage of biosorption increased from 5 to 48 % mg/g, respectively with an increase in contact time from 5 to 25 min **[6, 7].**

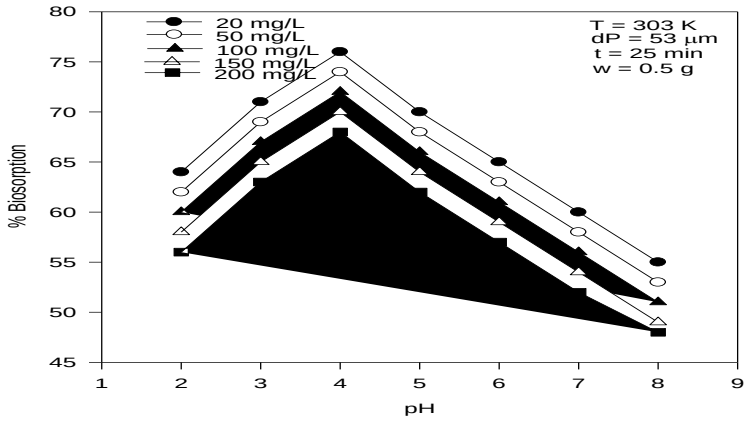
FIGURE1. EFFECT OF CONTACT TIME ON % BIOSORPTION OF CONGO RED USING *CLEODENDRUM FRANGRANS* LEAVES AS BIOSORBENT



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 for the removal of Congo red dye was studied. From the Fig.2. It was observed that the increase in solution pH from 2 to 4 for Congo red resulted in an increase in percentage of biosorption from 64 to 76 % for Congo red for an initial concentration of 20 mg/L. For an initial concentration of 200 mg/L, the percentage of biosorption was increased from 56 to 68 % for Congo red with an increase in solution pH from 2 to 4 **[8-14].**

FIGURE2. EFFECT OF SOLUTION PH ON % BIOSORPTION OF CONGO RED USING *CLEODENDRUM FRANGRANS* LEAVES AS BIOSORBENT



3.3. Effect of initial concentration of dye

The effect of initial dye concentration on the percentage of biosorption is shown in Fig.3. It is evident from the figure that the percentage of biosorption decreased with an increase in initial concentration of dye from 20 to 200 mg/L at all temperatures. The percentage of biosorption of Congo red decreased from 72 to 44 % and 78 to 52% for Congo red with an increase in initial concentration of Congo red from 20 to 200 mg/L at the temperature of 283 K and 323K, respectively **[15,16].**

3.4. Effect of biosorbent dosage:

The result obtained is shown in Fig.4, illustrate that the percentage of biosorption was increased with an increase in biosorbent dosage. The percentage of biosorption increased from 76 to 91 % from biosorbent dosage 0.5 to 4 g for an initial concentration of Congo red 20 mg/L. For an initial concentration of Congo red 200 mg/L, the percentage of biosorption increased from 68 to 83 % from biosorbent dosage 0.5 to 4g **[17-23].**

FIGURE3. EFFECT OF INITIAL CONCENTRATION OF DYE ON % BIOSORPTION OF CONGO RED USING *CLEODENDRUM FRANGRANS* LEAVES AS BIOSORBENT

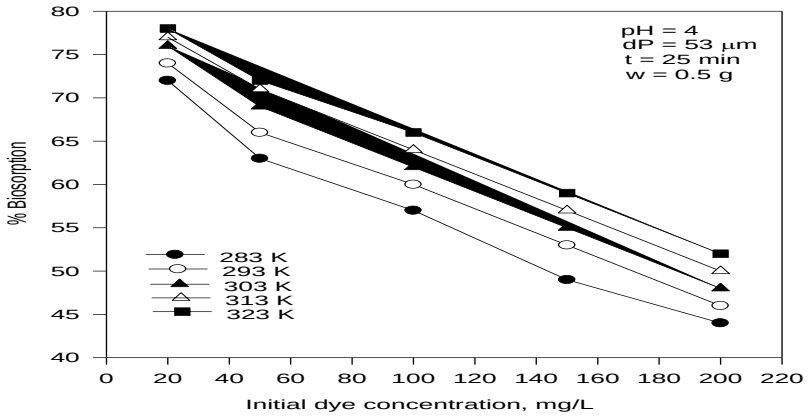
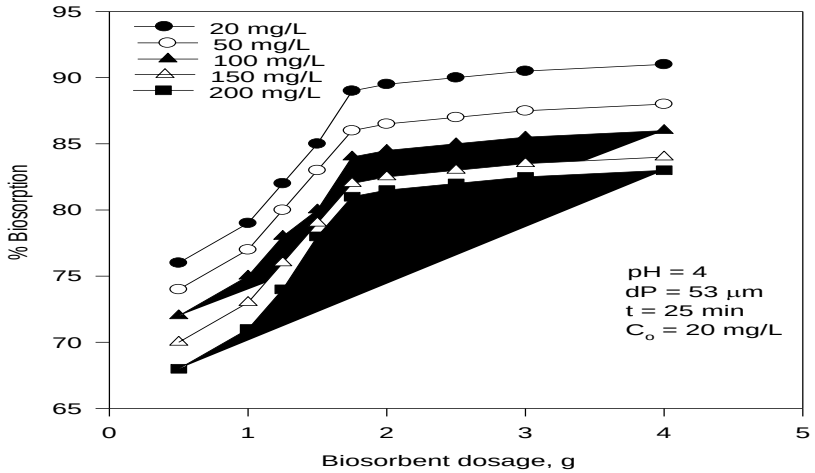


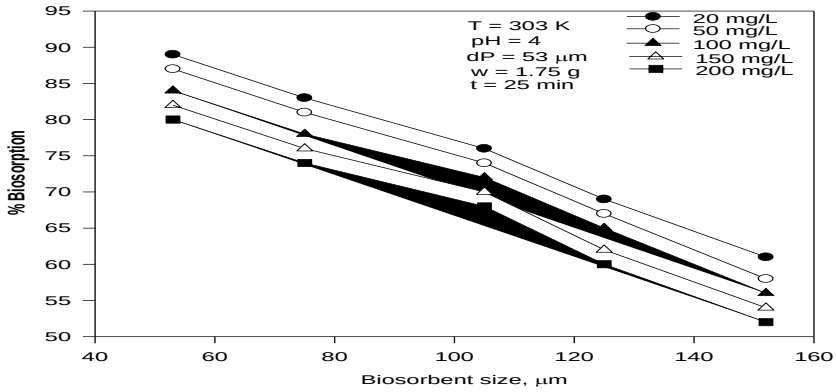
FIGURE 4. EFFECT OF BIOSORBENT DOSAGE ON % BIOSORPTION OF CONGO RED USING *CLEODENDRUM FRANGRANS* LEAVES AS BIOSORBENT



3.5. Effect of particle size of biosorbent:

The result obtained is shown in Fig.5. The result indicated that the percentage of biosorption was decreased with an increase in average particle size of biosorbent. The percentage of biosorption decreased from 89 to 61 % and 80 to 52 % with an increase in average particle size of biosorbent from 53 to 152 μm for an initial concentration of Congo red 20 mg /L and 200 mg/L, respectively **[24-30].**

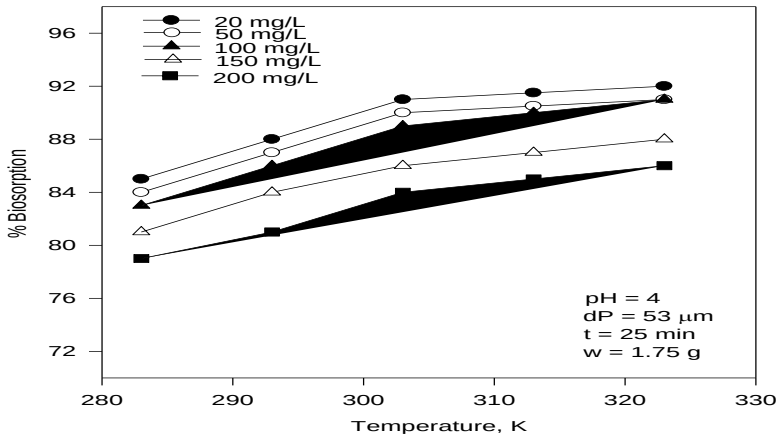
FIGURE 5. EFFECT OF AVERAGE PARTICLE SIZE ON % BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS LEAVES* BIOSORBENT



3.7. Effect of Temperature

The result obtained is shown in Fig.6, The figure indicated that the percentage of biosorption was increased with an increase in temperature of the solution. This suggests the endothermic nature of the biosorption process. The percentage of biosorption increased from 85 to 92 % and 79 to 86 % with an increase in solution temperature from 283 K to 323 K for an initial concentration of Congo red 20 mg /L and 200 mg/L, respectively **[31-37].**

FIGURE 6. EFFECT OF TEMPERATURE ON % BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT



4. EQUILIBRIUM STUDIES

4.1. Langmuir adsorption isotherm:

The applicability of Langmuir adsorption isotherm model was analyzed using the experimental data by plotting C_e/q_e versus C_e. Fig.7.show the Langmuir plot for the biosorption of Congo red dye at a temperature 303 K and The separation factor (R_L)

values at different initial dye concentrations for the dye was determined and shown in Fig.8. **[38-42].**

FIGURE 7. LANGUMUIR ISOTHERM FOR BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT.

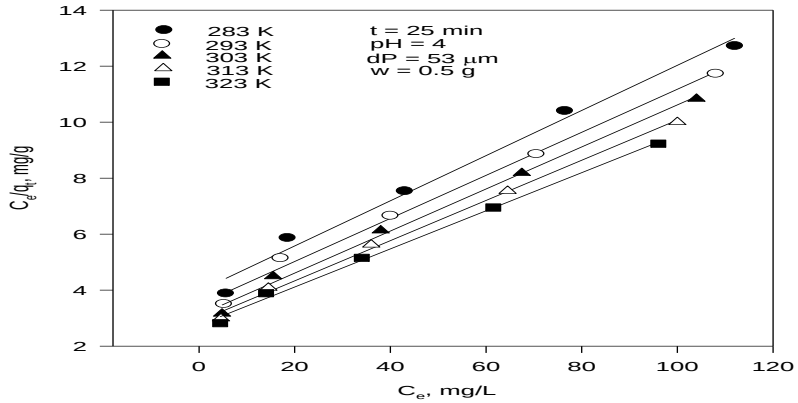
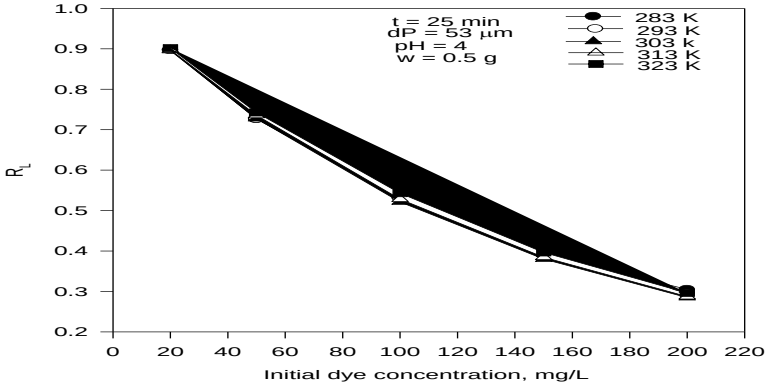


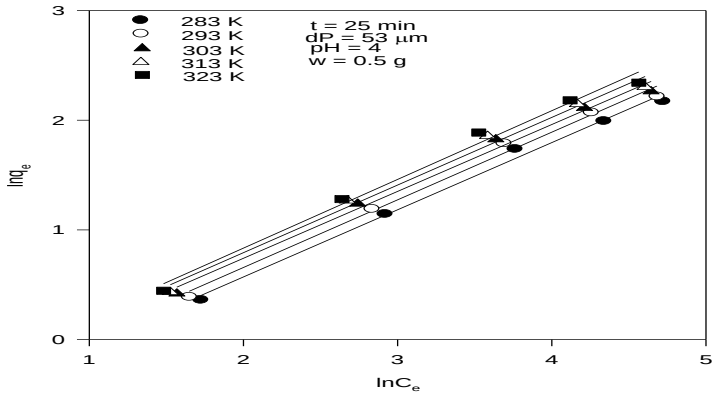
FIGURE 8. SEPARATION FACTOR FOR BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT.



4.2. Freundlich isotherm

The experimental data was tested for the fitness of Freundlich isotherm model by using linear graphical method. The biosorption data was analyzed by plotting ln q_e versus ln C_e shown in Fig.9.

FIGURE 9. FREUNDLICH ISOTHERM FOR BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT.



4.3. Temkin isotherm

Temkin isotherm studies were conducted to evaluate the biosorption potentials and to assess the variation of biosorption energies during the biosorption of Congo red dye using *Cleodendrum fragrans* leaves as biosorbent. The biosorption data was analyzed according to the linear form of Temkin model and is shown in Fig.10, for the removal of Congo red dye. The linear Temkin isotherm constants B_T and A_T, were determined from the slope and intercept of the plots of q_e versus ln C_e .

FIGURE 10. TEMKIN ISOTHERM FOR BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT.

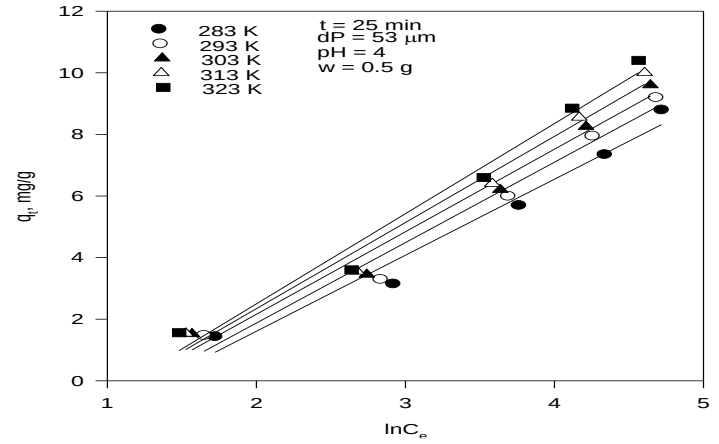


TABLE 1. BIOSORPTION ISOTHERM CONSTANTS FOR CONGO RED REMOVAL USING *CLEODENDRUM FRAGRANS* BIOSORBENT.

Temperature, T(K)	Langmuir isotherm			Freundlich isotherm			Temkin isotherm		
	q_{max}, (mg/g)	K_L, (L/mg)	R^2	n	K_f, ($mg^{1-1/n}$ $L^{1/n}$/g)	R^2	b_T, (J/mol)	A_T, (L/g)	R^2
283	12.4069	0.0203	0.9876	0.6123	0.5202	0.9937	953.15	0.2594	0.9698
293	13.0055	0.0220	0.9931	0.6170	0.5614	0.9908	932.97	0.2774	0.9742
303	**13.3191**	**0.0241**	**0.9951**	**0.6099**	**0.6194**	**0.9904**	**939.97**	**0.3026**	**0.9769**
313	13.9275	0.0248	0.9966	0.6164	0.6438	0.9891	930.25	0.3123	0.9787
323	14.6907	0.0247	0.9962	0.6263	0.6579	0.9892	917.74	0.3177	0.9766

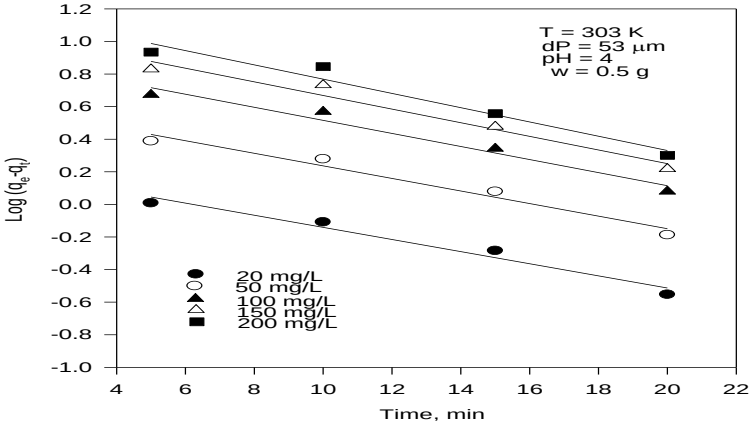
High correlation coefficient, R^2, values suggest that the biosorption process could be due to heterogeneous surface coverage. This is in good agreement with the result of Langmuir isotherm for Congo red dye.

5. KINETIC STUDIES

5.1. Pseudo- first-order kinetic model

The pseudo-first-order kinetic model was developed based on the solid adsorption capacity. The experimental results were analyzed to test the pseudo-first-order kinetic model and the linear plots of ln ($q_e - q_t$) versus t is shown in Fig.11.

FIGURE 11. PSEUDO FIRST ORDER KINETIC MODEL FOR CONGO RED BIOSORPTION ONTO *CLEODENDRUM FRANGRANS LEAVES* BIOSORBENT.



5.2. Pseudo-second-order kinetic model:

The values of equilibrium biosorption capacity and second order rate constants were determined from the slope and intercept of the linear plot of t/q_t versus t in Fig.12. The values obtained are tabulated along with the correlation coefficient (R^2) values in Table.2 for Congo red dye.

FIGURE12. PSEUDO SECOND ORDER KINETIC MODEL FOR CONGO RED BIOSORPTION ONTO *CLEODENDRUM FRANGRANS* LEAVESBIOSORBENT.

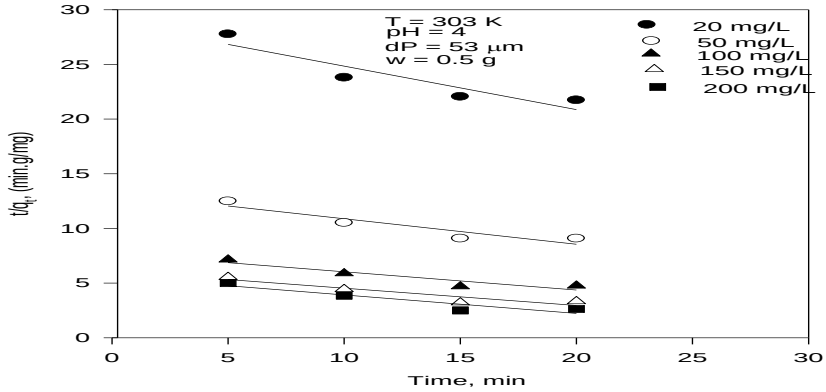


TABLE - 2.KINETIC MODEL PARAMETERS FOR CONGO RED REMOVAL USING *CLEODENDRUM FRANGRANS* BIOSORBENT.

Initial Conc, mg/l	**Lagergren-first order**			**Pseudo-second order**		
	q_e, (mg/g)	**k_1,(1/min)**	**R_1^2**	**q_e, (mg/g)**	**k_2(g/mg.min)**	**R_2^2**
20	1.2598	0.0856	0.9672	3.1338	0.0036	0.8390
50	1.8626	0.0886	0.9682	2.2497	0.0062	0.8760
100	2.5000	0.0921	0.9677	1.6270	0.0103	0.7910
150	2.9624	0.0962	0.9655	1.1724	0.0171	0.7715
200	3.3417	0.1016	0.9615	0.8325	0.0281	0.7582

6. THERMODYNAMIC STUDIES:

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 frangrans* leaves as biosorbent, the experiments were conducted and data were analyzed. The values of ΔH° and ΔS° were calculated from the slope and intercept of the linear Van't Hoff plot i.e ln (q_e/c_e) vs (1/T). These plots are shown in Fig.13 for Congo red dye. The estimated

thermodynamics properties along with the correlation coefficients (R^2) are tabulated in Table-3.

FIGURE13. VAN'T HOFF RELATION FOR THE DETERMINATION OF THERMODYNAMIC PARAMETERS FOR THE BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT.

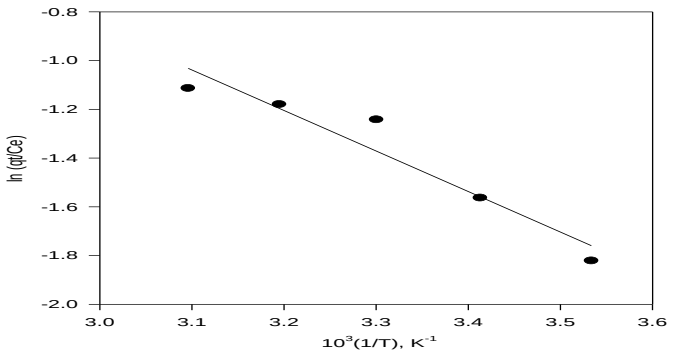


TABLE.3: THERMODYNAMIC PARAMETERS FOR THE BIOSORPTION OF CONGO RED ONTO *CLEODENDRUM FRANGRANS* LEAVES BIOSORBENT.

Temperature, K	**Congo red**		
	ΔG^0 (kJ/mol)	**ΔH^0 (J/mol)**	**ΔS^0 (J/k)**
283	–2.2269	31.8340	78.8019
293	-2.3057		
303	–2.3845		
313	–2.4633		
323	–2.5421		

7. CONCLUSION

The data obtained from the biosorption studies showed that a contact time of 25 min was sufficient for the maximum removal of Congo red dye from aqueous solution using *Cleodendrum fragrans* biosorbent. The experimental data of biosorption of the dye onto the *Cleodendrum fragrans* biosorbent fitted well with the Langmuir isotherm model. The isotherm reveals that the biosorption of the dye onto *Cleodendrum fragrans* biosorbent was favourable. The maximum removal efficiency was predicted to be 93.54% at a temperature of 303.4865 K, solution pH of 3.9991, and initial dye concentration of 19.6312 mg/L and biosorbent dosage of 1.7660g.

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CLASS ROOM MANAGEMENT DURING A GROUP DISCUSSION IN ENGLISH; THE CASE OF MADA WALABU UNIVERSITY FIRST YEAR ENGLISH LANGUAGE AND LITERATURE STUDENTS

Samuel Leykun[1, 2], Negash Demise[1]

ABSTRACT

The main purpose of this study was to assess class room management during group discussion in English in the case of Madawalabu university first year English language and literature students and to suggest ways of improving class room management while group discussion in English . The study has both general and specific objectives so as to achieve its goal and purpose. For the effectiveness of the study both primary and secondary data collection tools wave applied. Questionnaire and class room observation were used to collect data from the subject of the study. In order to collect data, the researcher used random sampling method. From the subject of the study 10 students and 4 teachers generally 14 respondents were selected to fill the questionnaire. In addition to this, classroom observation was conducted by the researcher to strength then the results of the questionnaire, qualitative and quantitative data analysis were used to analysis the data. Following data analysis, interpretation, conclusion and recommendations were given based on the research findings. From this findings and suggestions some ways of improving class room management during group discussion in English has been drawn.

Keywords: *Madawalabu, Quality education, group discussion*

Citation: Samuel Leykun, Negash Demise (2019). Class Room Management During A Group Discussion In English; The Case Of Mada Walabu University First Year English Language And Literature Students. Daagu International Journal of Basic & Applied Research-DIJBAR. volume1, Issue-2, pp (61-79)

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Received: 30/06/2019

Accepted: 30/08/2019

Published: 29/12/2019

OPEN ACCESS

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1. INTRODUCTION

Classroom management has been defined by different scholars and researchers based on their understanding and perception. According to Everston and Weinstain (2006) cited in website http://www.apa.org/education/k12/classroommanagementaspox "classroom management is a crucial and positive part of educators professions. Classroom management has two distinct purposes. It not only seeks to establish and sustain an orderly environment, so students can engage in meaningful academic learning, it also aims to enhance student's social and moral growth." However, classroom management was not well known in Ethiopia before certain years: especially during group discussion in English lesson. During curriculum of old education policy, teaching based only on delivering from teachers to students. One of the most common and traditional form of classroom management is corrective discipline, in which the classroom teacher deals with problems once they occur. There is a little or no attempt at prevention often corrective discipline involves some form of mild punishment such as time out, respond cost or social disapproval. Historically in classroom management, the teacher was thought of as a director. However, in a new curriculum of education policy, students centered and classroom management become essential. In the current learner –centered trend in classroom management, the teacher is more of guide, coordinator and facilitator.

1.1. Statement of the problem

Many scholars work have so for been dedicated to the study of various aspects of classroom activates. Even so, there are many reasons that made the researcher choose classroom management during group discussion in English. Among these, most classes at my high school, preparatory and even at University level there were problems concerning to classroom management, especially during group discussion in English. Due to these, the researcher wants to conduct a research in order to dig out the reason behind. Classroom management is the most important activity to be address education into the goal. The most effective activity can be made almost useless if the teacher does not organize classroom and students properly, and disruptive behavior can disturb the best classes if it is not checked. Teachers who do not use variety of students grouping may be missing valuable opportunities to create cooperative atmosphere in the class and maximize students practice. For some teachers, some sort of classroom management problem is a daily occurrence. These problems may include simple infractions of school, classroom rules, they may involve more serious events including disrespect, cheating, laughing, using mother tongue and acting out of instructions during group discussion in English. Therefore, the researcher wants to discover the factor the affecting classroom management during group discussion in English at Mada Walabu University first year English language and literature students and find out possible solution for the problem based on the findings.

1.2. Objective of the study

The general objective of this study is to find out the factors that affect classroom management during group discussion in English at Mada Walabu University first year English language and literature department students and search out ways of improving classroom management during group discussion to make the classroom better and active pace of learning.

The specific objectives of this study are:-

i. To identify students and teachers related problems that hinder the classroom management during group discussion in English.
ii. To distinguish factory that motivate students to come out of classroom discipline while discussing in the classroom.
iii. To propose ways of improving students' bad behavior during group discussion in English.
iv. To identify the role of group work in education
v. To find out the attitude of students to ward having group discussion in the classroom.

2. THE CONCEPTUAL FRAME WORK

Different scholars and educator define classroom management in different ways. According to Wright (1987) and Harmer (1991) citied in At kin 1996:181

> *Classroom management refers to the ability of a teacher to create healthy conditions of learning in the classroom use appropriate strategies for managing classroom tasks and activities; and assess and evaluate teaching activities effectively in terms of learning out comes.*

This quoted notion implies that controlling classroom and using the healthy conditions or comfortable condition for the teaching and learning in academic performance is based on the ability of teacher and also teacher assess and evaluate tasks, and activities in terms of learning out comes. As this scholar, class room management is a very broad term that one cannot give a precise and clear definition. Berhanu and Boko 2007:136 defined classroom management as the following based on their perception:

> *Classroom management is multi-faceted activities it extends beyond some of the more traditional behavior managements techniques frequently recommended to deal with students disruptive behavior classroom management involves teacher actions to create learning environment that encourage positive and social interaction active engagement in learning and self-motivation.*

Berhanu and Boko discuss that classroom management is a crucial activity in the teaching learning process and advice students who discreet classroom and then encourage positive attitude to engage students into active learning. In addition to these Mohanty 2007:253 explained classroom as the following: "classroom is a place where the future citizens of the county trained and enabled to meet the new challenges and to face the challenging situations in their life." This implies that classroom is a place where the new generation of the country gets knowledge, share experience and bring attitudinal change of students. Moreover, according to cited in website http://www.opa.org/education/k12/classroom management as pox.

> *Classroom management often called classroom discipline has been priority for teachers for nearly 40 years. Or for as long as there have been opinion surveys of educational priorities. Teachers went to assistance which classroom management because of their concerns about students safely and their desire for strategies to deal effectively with students disruptive behaviors. Educators have consistently rated discipline as one of the most serious obstacles to promoting effective teaching additionally, classroom management has been cited as one of the most prevalent reasons for burn out and teachers concerns over their own safely directly related to the use of effective classroom management program.*

Having says these much regarding to classroom management, let me hasten to how making transition cause difficult to control students in the classroom during group discussion in English. Classroom management have been studied from different disciplinary perspectives by many scholars; Educational psychologist, pedagogies curriculum designer and so forth. Some difficulty of classroom management is occurring during transitional activities takes place. Everston and Emer stated their ideas about problems of transition citied in Borich 1982:176 as the next:

> *Transition is one of the main difficulties to keep students' attention during transition from one instructional activity to another. Moving the entire class from one activity to another in timely and orderly manner can be a major undertaking. These problems are at the first time learners are not ready to perform the next activity. Then learners have unclear expectations about appropriate behavior during transition. When students are uncertain or un aware of what is coming next. They naturally become anxious about their ability to perform their transition. This is the time when transitions can get noisy.*

The above text contains dual aspects; the first one is that when moving an entire classroom from a given activity to another at the sometime. It is difficult to control the students' attention. The other aspect is students are act of control and then they make noisy in the classroom. Not only transitional activity that can make problem in classroom activity. But also using mother tongue during group discussion in English is another main problem. We will see its impact under the next topic.

2.1. The impact of using mother tongue during group discussion in English

Many scholars and researchers discussed that using mother tongue or native language brings tremendous impact on English language during group discussion. During learning in English, majority of students use their first language when they discuss on a given issue. However, using this mother tongue would have many problems on learning and practicing the rule and regulation of English language. To strength this notion Harmer 1991:247 states that:

> *One of the biggest problem in the used of pair work or group work is the use of mother tongue by students in monolingual groups. It sometimes seems that they are unable or un willing to take part in activities in English. When students respect in their own language rather than English during group discussion activity in the classroom, then, clearly the activity is fairly pointless.*

This view indicates that most students use their native language during group discussion rather than in English language. While the students are discussing in their first language the opportunity of improving English language is very narrow. A part from this their linguistics competence is become less. According to Katz and Skele

cited in Karunaratne 1998:167 touches up on the impact of using mother tongue in group discussion as "the use of mother tongue by teachers and students seemed to fulfill a number of classroom requirement." This idea indicates that when both teachers and students are use native language they take as all matters that required from them are completed. In order to overcome this problem and minimize the use of mother tongue during group discussion in English teachers have to contribute their endeavor as much as possible. Harmer 1991:217 states his view as the following:

> *Teachers play a great role in minimizing the use of mother tongue during group discussion in English. To prove teaching learning process. To be more appropriate to teach English successfully. The major part of teachers' job is to assess the students' work to see how well they are performing or how well they done a given task using English language.*

Harmer states that teachers have to take in to account the work of students as well as the language they use during group discussion. Teachers control what the students do as well as what language they use in the period of group discussion. Due to this, the researcher expects that teacher has great role to minimize the use of mother tongue in English lesson.

Sofar, we have seen how transition and using mother tongue made great problem in the time of group discussion in English. Besides to these, large class size has also its own impact on group discussion. Let see its impacts under the next topic.

2.2. The Impact of Large Class Size during group discussion

Many scholars and researches were listed the large class size challenges that faced teachers during classroom management and teaching English. Especially during group discussion in large class size. Refers to this view Atkins 1996: 181 discuss the effects of large class size on teachers during teaching English language and managing classroom based on his perception as follow:

> *Creating healthy conditions of learning in large classes is a serious challenge for the teacher of English as a foreign language. Thus, classroom management is a crucial issue in the English language teaching class in Ethiopian Schools where the average class size is wider.*

Atkins indicates that making motivation and good condition for learning in large classroom is so challenging while teaching English language. On the other hand, teachers face various challenges when they are teaching in large class settings. For example, difficulty in maintaining good discipline, students may fell discomfort problems in giving equal attention for all students. Regard to this, the British Council teaching English methodology in the Website http://www teaching English org.uk underlines. "It is difficult to keep good discipline in a large class and teacher cannot easily give each student the individual attention they need." This indicates that in large class a number of students are occur so in such class it is so difficult to control all class students discipline as well as given attention to all students work appropriately. In order to strength the above view A.K Nayaka and V.K Rao 2004:227 state their idea about large class size as follow:

> *Learning occurs in proportion to class size large class has its own affect on group discussion and has negative effects on student's behavior and learning. However, the smaller class and the more students learn small classes provide more*

> *opportunity for feedback and discussion than large classes as well as greater students satisfaction.*

This quote implies that large class size has a number of impacts on students and teachers particularly during group discussion in the classroom. In such classes the disciplines of classroom become uncontrollable. But, in small classroom, students can get good opportunity for feedback and satisfaction. Even if, in large classis, students may fail to get equal change for language practice. According to Marry under Wood cited in Horrington 2006:52 support this idea. "---- in large class it is easy to miss some students out when doing different language practice" Marry wants to discuss that in large class the teacher easily miss some students when he made students language practice, because large class size and a number of students occurs in the classroom. On the other hand in such large class, students' participation is low and they copy each other's work. Even, technical problems can be face the teacher during working with such class like monitoring of attendance can be difficult, thus encourage students to cut classes. In general, Atkins (1996): 215 try to list the main problems of large class size as the following.

i. Students make a lot of noise and it is difficult to keep discipline.
ii. Evaluation of each individual student's progress cannot be done.
iii. Teachers find it difficult to know who is who in the class.
iv. The needs of individuals' students cannot be met.
v. Challenging and demanding exercises that are valuable for language learning cannot be used in large classes.
vi. Students' participation is low and
vii. Students' copy each other's work.

We have seen that how large class size brings impact while teaching and learning and also during group discussion. Now let us proceed to look disruptive behavior in the classroom during group discussion in English.

2.3. Disruptive behavior in the class room during group discussion

Classroom discipline is another major factory that affects the creation of healthy conditions of learning. Different scholars are agree on personality of teacher is more important as a factor in successful discipline in the classroom, others are agree on kinds of learning tasks are more important as factor in successful discipline in the classroom. Many writers argue that the relationship quality of the relationship in the classroom is the major contributing factory in class room discipline and that this basically depends on the personality of the teacher. For example, as Ur(1981) cited in Atkins (1996):190 says,

> *As regards discipline, this basically depends on the personality of the teacher and relation between classroom and teacher not on the type of activity on the whole, it is safe to say that a class which is controlled in teacher fronted work will be controlled in group work.*

Ur explains that the relationship between teachers and students are the major contributory factors which help the teachers to manage the discipline that occur in the classroom.

On the other hand, as Wright (1987) cited in Atkins (1996): 190 argues, the above idea as the next opinion:

> *It may be true that teachers who are predisposed towards communicating with others, and who are interested in learners as people, are more likely to succeed in the classroom than those who regard teaching only as the routine transmission of knowledge. On the other hand, a teaching style that is centered on personal relationships rather than on learning tasks can only succeed if the learning group accepts such a strategy or the school authorities sanction such behavior or parents and other sponsors believe this to be in the interests of the learners.*

Wright (1987) wants to discuss that the tendency of teacher to ward communicating with others and has interest of learner are more contributing factors in the classroom discipline succeed rather than only continuously delivering knowledge to students. Among the writers, the researcher also supports the Wright's opinion. Because, to be manage the discipline in good manner, it is appreciable if the teacher have good relationship with students and excellent at teaching. There are various matters which disturb classroom in the time of group discussion. According to Smith and Webb cited into Marshal etal 2004:86 they describe some matters which bring disturbance in the classroom as the follow.

> *Some students use mobile phone for text message stand out as a new form of disruption to enter the classroom. Furthermore, while lecturing and group discussion some students are chat to each other, send each other written text. More extreme form of disruptive behavior, students throwing dirty papers of engaging in heated shouting matches with lectures are rare but common. These behaviors can be disconcerting for the lectures and disrupting for these students who do want to learn. While students are chatting during group discussion lecturers may be reluctant to ask for advice in how to deal with it as there is a perception that 'good' lecturers.*

Smith and Webb say matters with can be making reason to disturb the classroom during group discussion and while lecturing. Some students are use mobile phone and some others are chatting each other, while others are discussing in the classroom. When some of them chatting and others are shouting the discipline of classroom is become out of rule and regulation of classroom.

Similarly, as Morand described in Jagannath (2007) "….. Excessive taking, passing notes or using and passing electronic devices and disturb the lecture and learning environment during classroom time." Morand try to states more talking in classroom and using electronic devices are considered as factors that can affect classroom. These all what the researcher tries to discuss so far are the main factor that affecting classroom management during group discussion in English. Later on, the researcher is on traveling to proceed to discuss how motivate students to engage in classroom activities.

2.4. Motivating students to engage in classroom activity

The term motivation is defined by many scholars and researchers in different words. According to G.M Blaire et al (1947) quoted in Berhanu and Boko 2007:114 "motivation is a process in which the learners' internal energies or needs are directed toward the desired goal." This notion implies that motivation is a process in which facilitate students to ward activities. In other words, motivation is a major determining

factor in promoting healthy conditions of learning. Learners maybe motivated to learn English because they would like to integrate with the culture and community of the target language. In this sense students would like to be considered as, or approximating to the ability of, native speakers. Thus, they maximize their efforts to learn the language in order to achieve integration. When students are motivated, they may enjoy to some degree with native speakers of the language and also to use the language for academic and vacation purposes. Motivation is the main and essential parts for practical and engagement of language and during group discussion. Stella R. 2006:135 states her ideas as this: "motivation and engagement are essential for effective learning and everyone knows it but it has not always been easily to demonstrate how students influence learning and achievement." This quoted view implies that facilitating and encouraging students toward education is the better. However, it is difficult to in which ways it will be happened and implement. On the other hand, "less motivated students are passive, do not try hard and give up easily in the face of challenges" (ibid). This means if students are not motivated during group discussion and other activities, students are not satisfied and not become hard workers students. Regarding to this Wright (1987) contributed his opinion in Atkins (1996): 183 as the next one.

> *The primary function of a teacher's management role is to motivate those learners who are demotiveted and to nurture those who are already well motivated to the task of the learning a foreign language.*

Wright indicates, the primary goal of teacher is to motivate students as they engage to practice English language. Therefore, as a researcher motivation has great role in the promotion of students' attention, attitude and relation toward group activities in order to address their Endeavour into the goal.

After we have seen the role of motivation in group activity then the researcher would like to invites the readers to look over the students centered learning in short. Many scholars define the term students centered in different ways based on their perceptions students centered is the modern mechanism of learning in which students are co-operate and do the different activities by getting teacher's facilitate with great responsibility in the hands of students. On the other ways the term students-centered leanings is widely used in the teaching learning techniques. Many terms have been linked with students centered learning like self-directed learning and experiential learning. Refers to some of the literature on students centered learning Stella R.2006:100 states that following ideas.

> *Student centered reliance on active rather than passive learning, increase responsibility and accountability on part of the students, inter-dependent between teachers and students create mutual respect within the learners' teacher relationship.*

This indicates that, students centered learning is move facilitate students and make them active rather than passive during learning in the classroom. Moreover, students centered make students independent and relationship among students. In other words, students should be encouraged to participate activity in group discussion and co-operative learning activities. Therefore, the role of students' participation to. Enhance the teaching and learning process can be valued from different angles. Generally, the

main strategy of students centered is to make active in a queering knowledge, share skills and make students move aware of what they are doing and why they are doing. The last point but not the list on which the researcher attempt to discuss is the advantage of group discussion.

2.5. The advantage of group discussion

Before directly hasten to the advantage of group discussion, let me touch up on the definition of group discussion. Different scholars and researchers define the term group discussion indifferent ways based on their perceptions. Rao and Nayako, 2004:229 define group discussion in this ways:

> *Group discussion is the major device of language teaching this method of language teaching is very essential for various purposes: to increase students' participation, to treat psychological problem of students and minimize one way communication in language teaching.*

For Rao and Nayako group work is the appropriate way to teach and learn language and facilitate students' participation and practice of language. A student has some responsibilities in order to maximize their own learning and that of others in group discussion. Teachers also need to assign students to learning group activities and sometimes give students specific roles to undertake in the group as well as monitor the functioning of the group as students are not out of instruction. In order to make acceptable the above idea, Atkins (1996): 206 state his opinion as the following:

> *Group discussion allow students to use language encourage students cooperation and joint learning. However, if they are not well-managed they may promote: errors, noise, ill-discipline, frustration and anxiety. Moreover, if the activity to be performed is not appropriate to the ability and interests of the class, if is not well timed and well prepared, the activity may not help to meet the intended objective. If pairs are not organized according to students' preferences, some students may not like to work with the students they have been assigned to work with.*

For Atkins, group discussion is assist students to promote the ability of language. But students need good management in order to succeed, unless and other ways they may come out of classroom discipline, and create noise, frustration and others else. On the other ways, Atkins believes that, to be performed group discussion is better if it is based on the interest of students, it not based on the students interest, and they make only shallow discussion, which is not touch up on the core issue or intended objective. Harmer 1991:249 contributes his view again about the importunity of group discussion as follow:

> *In learning second language, group work is crucial for students to share their experience freely and confidentially to teach each other. In some way of group work, there are make people to react with and against in group and therefore, there are greater possibility to discussion; a greater chance that at least one member of the group be able to solve a problem, when it arise, and working in Paris on students ability to cooperate closely with only one person.*

Harmer, wants to discuss that, when move students come together and make discussion on a given task, they react each other and against in group. During this period, the members are discuss widely and then come across with solution. Because of this, being in group is better than being alone. Besides to these, to be cooperative a group may

have positive interdependence. Members of the group promote each other's learning and assess face to face use the hope full internal persona skills to be effective group discussion. Others scholars highly support this view. A.K Rao and A.V. Nayaka. 2004:229 point out as follow:

> *Group discussion and interaction challenge students thinking and encouraging them to consider issues from different point of view. Group work develops cooperative, attitude and behavior; students learn the value of sharing and helping each other as well as tolerance and resections.*

This implies that, group discussion can make students make and more thinkers and create habit of sharing good experience as well as tolerance among students.

3. METHODOLOGY AND RESEARCH DESIGN

This chapter deals with the methods and techniques that are used to conduct the study and overall design of the data collection. Generally, under this chapter the sub-title to be considered is: population, sample and sampling techniques, data collection tools and methods of data analysis and interpretation.

3.1. Population

The target population of the study was focused on Mada Walabu University first year English language and literature students who enrolled in the academic year of 2004 E.C. they were selected as subject of the study because classroom management was not actively involved in English according to the researcher observation. Due to this, the researcher selects Mada Walabu university first year English language and literature students as subject of the study and also took a sample of teachers to fill the questionnaire.

3.2. Sample and Sampling technique

To gather than data from the population of Mada Walabu university first year English language and literature students random sampling techniques used. Because, this method is simple to use save time as well as budget. By using random sampling technique from total number of 30 students, only ten students were selected as a sample to fill the questionnaire. There are four English major course teachers who teach first year English language and literature students. The other two teachers give common courses. In order to get real information, the researcher gave equal chance for all English major courses teachers to fill the questionnaire:

3.3. Data collection Tools

The researcher used both primary and secondary data collection tools for the effectiveness of the study. Observation and questionnaire are used as primary and secondary data collection respectively.

3.3.1. Observation

Observation is the most commonly method in qualitative research for the purpose of gathering full range and depth of information or data relevant to the study. There for, the researcher select observation as a primary data collection to see the actual problem. To observe the classroom management the researcher used five observation check lists.

These observation checklists are focuses on class room management during group discussion in English and attached an appendix part.

3.3.2. Questionnaire

Questionnaire is also a popular form of secondary data collection tool consisting a number of questions printed or typed. For the purpose of conducting this research, the researcher developed the questionnaires. The reason why the researcher used questionnaire is due to the fact that it is less expensive, produce quick result, filled at the respondents' convenience and wider coverage of data. The researcher administered a questionnaire for both students and teachers which consists open and closed ended questions. For the sample of ten students, five close ended and two semi-close ended were used. In general, twelve questions were used to get the required data. The secondary data also used to get actual data for the success of the research project entitled classroom management during group discussion in English at Mada Walabu university first year English language and literature students.

3.4. Method of data Analysis and Interpretation

After collected the necessary data with the help of questionnaire and observation methods the data have been analyzed. This was done first by editing the collected data to avoid some errors in the data collection. Then, the researcher classified the responses according to their similarity to defined groups and described the relationship and also strengthened the result by using observation and questionnaires. Based on the nature of research and types of data gathered qualitative method was used. Then, the analyzed data was organized in tables containing items variables, number of respondents and percentage.

4. ANALYSIS AND INTERPRETATION

After the data were collected, they were analyzed by using the procedure of quantitative and qualitative data analysis. The analysis and interpretation is about classroom management during group discussion in English at madawalabu university first year English language and literature students. The analyzed data obtained through students and teachers questionnaires. As well as classroom observation.

4.1 Analysis of students questionnaire

TABLE 1: STUDENTS' PREVIOUS EXPERIENCE OF HAVING GROUP DISCUSSION WITH THEIR FRIENDS.

Reflections	Respondents in number	Percentage
Most of them	2	20
Sometimes	5	50
Rarely	2	20
Not at all	1	10
Total	10	100

As the above table shows, 50%of the respondents reflected that they have past experience of making group discussion. With their friends in English. But, this is practiced sometimes 20%of the respondents suggested that they were previously

making group discussion most of the times. The remaining 20% and 10% of the respondents have responded rarely and not at all respectively. This clearly indicates that the previous experience of students having group discussion was limited.
Generally, having previous experience is very important in order to improve group discussion process in the classroom.

TABLE 2: STUDENTS INTEREST ON MAKING DISCUSSION DURING LEARNING IN ENGLISH.

Item	Like very much		Like		Dislike		Dislike very much	
Do you like making group discussion when you learn English?	No	%	No	%	No	%	No	%
	7	70	2	20	1	10	-	-

As one can see from the above table, 70%of the respondents reflected that they are very much interested to make group discussion when they learn English. 20% of them suggested that, they like to do it sometimes and the remaining 10% proposed that they dislike making group discussion in English. Whatever their reflections are the respondents mentioned different reasons. Those who suggested they are very much interested mentioned different reason. These are:-

i. I prefer learning English using group discussion because it helps me to get the concept of the lesson
ii. I like making group discussion in learning English. Because it helps me to develop confidence.
iii. I like making group discussion because it makes me participator in the classroom.
iv. Similarly, respondents who responded ‘like’ also stated their reason as the following.
v. I like making group discussion because; it helps me to know what I do not know before.

The rest 10% of the respondents who dislike making group discussion in English. But, they have not mentioned any reasons for that. The above result implies that, most of the respondents seem very much interested in making group discussion when they learn English. However, it is necessary to give attention for about 10% of the respondents who preferred dislike learning English using group discussion.

TABLE 3: FREQUENCY OF PRACTICING ENGLISH LANGUAGE IN GROUP DISCUSSION.

Item	Most of the time		Some time		Rarely		Not at all	
How often you are practice English language in group discussion?	No	%	No	%	No	%	No	%
	2	20	6	60	1	10	1	10

As vividly seen from the above table, majority of respondents that is 60%, agreed that they have the chance of practice English in group discussion some times. And 20% of said most of the time.10% responded rarely and the remaining 10% reported that, they

do not practice English at all. The above result suggested that, the majority of the students practice speaking English in group discussion is sometimes. Knowing students' interest and preference on making group discussion while they are learning English have great value to the lesson learner centered, interesting and attractive.

TABLE 4: GROUPING MECHANISM FOR EFFECTIVE GROUP DISCUSSION IN ENGLISH.

Item	Whole class		Group work		Pair work	
	No	%	No	%	No	%
What kinds of mechanism you use in learning during group discussion?	3	30	5	50	2	20

As clearly shown in the above table, 50% of the respondents are reflected that making discussion in group work has more advantageous to make effective discussion. Taking this in mind, the following are the basic reasons for their responses and many of the respondents share their reasons.

i. If the discussion is whole class, the class will be disturbed and turn taking and giving chance for others may not be fully delivered. Due to this reason, I prefer group work.
ii. Group work is the prefer way for effective discussion. When we compare group work with whole class discussion, introduce disturbance in the class room.
iii. In contrary, other group of respondents, which is 30% suggested that using whole class for discussion has great value. According to the respondents, the following are the basic reasons.
   a) I prefer discussion with whole class to develop my language Skill. Because, language is a skill that can be developed only through practice and the whole class discussion gives a chance to do so.
   b) It helps us to develop confidence.
   c) On the other hands, the other respondent, which is 23%, suggested that using pair work for discussion has great value. According to the respondent:
   d) I like pair work because in pair discussion the class will not be disturbed and helps us to understand each other.

From this table, it is possible to for caste that the majority of the respondents prefer group work. Additionally, as the researcher observed group work did not create disturbance in the classroom. Because, the output of the researcher indicates that group work is great valuable rather than whole Class and pair work discussion.

TABLE 5: FREQUENCY OF TEACHERS' USE GROUP DISCUSSION IN ENGLISH

Item	frequently		sometimes		Rarely		Not at all	
How often does your teachers conduct group discussion during teaching learning process?	No	%	No	%	No	%	No	%
	1	10	7	70	2	20	-	-

This table indicates that, 10% of the respondent reported that their teachers are frequently arranged and conduct discussion where 70% said that their teachers conduct discussion some times. 20% of the respondents responded that their teacher arrange

discussion. In general, we can clearly say the teacher does not make group discussion frequently, but they prepare group discussion sometimes more. To make sure that the researcher observed the classroom continuously in order to cross check whether the teacher makes group discussion frequently or some times. As a researcher it is better and valuable if teacher use frequently group discussion. Because through frequently using group discussion, students become active participator, fluent at speaking and became effective group discussion in the classroom.

TABLE 6: USING MOTHER TONGUE DURING GROUP DISCUSSION IN ENGLISH

Item	Strongly agree		Agree		Disagree		Strongly disagree	
Using mother tongue during group discussion in English	No	%	No	%	No	%	No	%
	8	80	2	20	-	-	-	-

As can be seen from the above table, 80% of the respondents strongly agreed that using mother tongue during group discussion in English is wrong. And 20% of the respondents agreed that using mother tongue while discussing in English is wrong no one of the respondents said disagree and strongly disagree respectively. From this finding, the researcher clearly observed that using mother tongue during group discussion is completely wrong. Because, using mother tongue during discussion in English is make trap to students and also it affect English learners as they not improve English language and perfect at speaking skill due to these, using mother language during English class is for bidden.

TABLE: 7 MAKING DISCUSSION IN LARGE CLASS SETTING

Item	Strongly agree		Agree		Strongly disagree		Disagree	
Making discussion in large class setting is boring.	No	%	No	%	No	%	No	%
	4	40	3	30	1	10	2	20

This table report that, 40% of the respondents strongly agreed that making group discussion in large class setting is boring. 30% of the respondents agreed that making group discussion in large class setting is boring. The remaining 20% and 10% of the respondents have responded disagree and strongly disagree respectively. From this result, one can understand making group discussion in large class is boring. This may arise from the classroom misbehavior and other else.

Generally, making group discussion in large class has multiple impacts on learning and teaching process. In wide class the discipline of class room is not respected and has effect on teaching process.

TABLE 8: FEEL AFRAID DURING GROUP DISCUSSION AND PRESENTATION

Item	Most of the time		sometime		Rarely		Not at all	
	No	%	No	%	No	%	No	%

Do you feel afraid when you speak in English during group discussion and Presentation	4	40	3	30	2	20	1	10

This table indicates, 40% of the respondents reflected that they felt afraid when they are make presentation in English and 30 % of the respondents said they are also afraid some tome. The rest 20% and 10% are responded rarely. And not at all respectively. To realize what the respondents were responded whether the respondents are felt afraid or not during group discussion and presentation, the researcher observed the classroom and proofed that they are feel afraid most of the time. In short, from this data the reader is understand the respondents have no confident while they are speaking in English during group discussion and presentation.

4.2 Analysis of teachers' questionnaire

The researcher included four from other common course teachers. Four of them were male and their year of teaching experience ranges from 1-2 and 6-10 years.

TABLE 9: TECHNIQUES IMPORTANT TO FOSTER EFFECTIVE DISCUSSION IN THE CLASSROOM

Activities	Respondents in number	Percentage
Groping students according their academic ability	-	-
Grouping students from different category of talents	4	100
Grouping slow learners together	-	-

This chart reflect that 100% of the respondents agreed with grouping students from different category of talents that means from active, medium and slow learners is effective was of grouping. No one of the respondents was agreed with other techniques of grouping students. From this result, it is possible to understand grouping students from different category of talents would be effective in order to foster effective group discussion. In addition to the above technique, the researcher also observed the classroom to cross check whether the learners are grouped according to their academic ability or from different category of talents as well as slow learners together, then proved that they were grouped according to category of talents. Concerning to these all, the researcher wants to suggest that grouping students from different of talents are more valuable rather than grouping according to their academic ability and slow learners together. Because, they share ideas, knowledge, experience and make effective group discussion.

TABLE10: FACTORS THAT AFFECTING CLASSROOM MANAGEMENT DURING GROUP DISCUSSION IN ENGLISH.

Activities	Respondents in number	Percentage
Using mother tongue	1	25
Large class size	3	75
Difficulty of topic	-	-

This table reflected that, 75% of the respondents agreed upon large class size have effect on classroom management during group discussion. Bearing this in mind, the following are the basic reasons for their respond.

i. Whenever I teach a large class size though the topics is not difficulty. I usually face difficult in managing the classroom situation.
ii. Usually in group discussion, student group should face each other, so that they can pay attention to other groups' discussion. Is not possible in large class.
iii. Teacher loses control over what other group is doing when some other group discussion.
iv. Large class is difficult to maintaining good discipline.
v. Unable to promote students interaction.
vi. Unable to observe and monitor all groups.
vii. Difficulty to reach at certain agreement on the same issue.

The other respondent agreed that using mother tongue during group discussion in English is more affect classroom management. However, the respondent did not state his idea about it and nobody said difficulty of topic. From this finding, the researcher suggests that since large class has great impact on teaching and learning process, it is better to teach students in small class. Because, small class contain small number of students and help them to share ideas, knowledge and experience.

what is the disruptive behavior in the classroom during group discussion in English?

Concern this question respondents gave different reasons. These are: the difficulty of topic (sometime), large class size, seating agreements, and exhaustiveness among the students particularly during the last periods and others. Not the only the above about disruptive behavior in the class room but also, there are others according to respondents:

- One's message may not be comprehendible to other members because of communicative language errors.
- Students do not voluntary to speak up.
- Hesitation, fear, lack of confidence that they may do mistakes.

From this result, it is possible to understand that bring different matters of disruptive classroom during group discussion are arise from lack experience of speaking language. Due to this it is essential to reduce the disruptive behavior in the classroom to be engaged in good classroom management.

TABLE 11: TEACHERS' ATTITUDE WHETHER LARGE CLASS HAS MERIT AND DEMERIT DURING GROUP DISCUSSION IN ENGLISH.

item	Do you think large class size has merit and demerit during group discussion in English?					
Variable	Merit		Demerit		Not sure	
	No	%	No	%	No	%
	1	25	3	75	-	-

As can be seen from the above table, 75% of the respondents agreed that large class size as no merit during group discussion in English. For this matter, the respondents shared their reason as follow:

i. Inability to control the class as the number of students per class increase, some students tends to engaged themselves on trivial affairs. There is also a problem of mother tongue inference when the group or class is large sized.
ii. There is nothing gained from large class size because, it is only convenient to make a lecture.
iii. The teacher may not give the required feedback for students.
iv. The teacher may not easily identify the skill and knowledge of his students.

On the other hand, 25% of the respondent supported large class size during group discussion in English and reflected his opinion as the following.

i. There is a lot of discussion and exchange of ideas or experiences.
ii. There is more brainstorming.

From the above result, anybody can understand as majority of respondents agreed upon demerits of large class size. As the researcher suggestion, in order to engage students and improve them academically teaching in small classroom with small number of students becomes more preferable.

4.2 Analysis for classroom observation

TABLE 12: ANALYSIS OF CLASSROOM OBSERVATION

No	Activities	yes	No
1	Do students have interest for group discussion?	√	
2	Do students use mother tongue during discussion in English?	√	
3	Does the teacher monitor all groups similarly?		√
4	Do students have confidence during speaking in English and group discussion?		√
5	Does the teacher conduct group discussion in the classroom?	√	

Class room observation table indicates that students have interest toward group discussion. Also the researcher observed the class room and proved they have interest of group discussion. Not only this, but also the students were use mother tongue during group discussion in English. However, while the students were using their native language, the teacher did not monitor and follow-up all groups in the same manner. In addition, even if the teacher conducts group discussion, students have no confidence during speaking in English. As the researcher suggestion, to build self-steam students have to practice English language and teachers also motivate them again and again. Generally, classroom observation of thee researcher helps to observe directly the actually problems and proved the results gained through students and teachers questionnaire.

5. CONCLUSION AND RECOMMENDATIONS

From the analysis obtained through teachers and students questionnaire as well as class room observation. It is possible to conclude as the following:-

i. This study indicates classroom management during group discussion in English at madawalabu university first year English language and literature students.
ii. The study result demonstrate that, group work has more advantageous then whole class and pair work in order to make effect and success full discussion, it enable the students to share ideas, knowledge and promote common good.
iii. The result of the study reveals that using mother tongue during group discussion in English is wrong. However, students use it when the topic is difficult to them as well as when lack of words faced them.
iv. The other major finding of the study shows that, making group discussion in large class setting is boring. This arises from suffocation of classroom and misses behavior. In addition, large class size is difficult to form groups immediately as the teachers gives instruction, difficulty in maintaining good discipline and unable to promote students interaction.
v. The result of the study described that different disruptive behavior have seen during group discussion such as students laugh at students to whom make grammatical mistake and noisy of the group can disturb the discipline of classroom.
vi. Finally, the study revealed that 100% of the target teachers agreed that grouping students from different category of talents that is active, medium and slow learner is the most important in order to share experiences, knowledge and to promote the ability of speaking and participation in the classroom during group discussion.

Recommendations

The study was conducted to look into class room management during group discussion in English. Furthermore, it aimed to forward possible solutions that enable manageable classroom management during group discussion in English. Therefore, the teacher has suggested the following constructive recommendations based on the findings.

i. It is recommendable that, at the start of group discussion the teacher should inform the students' clear rule of behavior that they must follow during group discussion in English.
ii. Teachers have responsible to manage all groups properly as they not use their mother tongue during group discussion in English.
iii. It is advisable that students have practice English language always to develop the language in order to speak fluently. To do this, students should be joining to English language improvement center.
iv. It is recommendable that teachers have responsible to conduct always group discussion in the classroom. Because, it help students to share ideas, experience and expand students' knowledge.

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