Journal of Science and Sustainable Development (JSSD)

Volume 9 Number 2

2021

iSSN: 2304-2702 (Print)
: 2414-4479 (online)

An International Journal of Ambo University

Journal of Science and Sustainable Development

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Journal of Science and Sustainable Development (JSSD)

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Journal of Science and Sustainable Development (JSSD)

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- To promote the effective teaching of science, technology and management; identifying problems and developing solutions through dissemination of new information from researches align in the direction of solving the basic need of the country.

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Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; Chukwura, 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001)

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Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillinresistant *Staphylococcus aureus* in community-acquired skin infections. Emerg. Infect. Dis. 11: 928-930.

Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. Afr. J. Biotechnol. 7: 3535-3539.

Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing *Escherichia coli* in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51:1281-1286.

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Journal of Science and Sustainable Development (JSSD), 2021, 9(2), 1-17

ISSN: 2304-2702 (print); 2414-4479 (online)
DOI:10.20372/au.jssd.9.2.2021.0329 [1]

RESEARCH PAPER

Ethnobotanical Survey of Medicinal Plants Used by Local People in Hintalo Wajerat District, Northern Ethiopia

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Abstract

Indigenous people of different ethnic groups in Ethiopia are enormously reliant on traditional medicinal plants to fulfilling human and livestock healthcare needs and have been used over many centuries. This study was conducted to document different types of herbal medicinal plants used and the traditional knowledge held by the local people in Hintalo Wajerat District. The techniques used in ethnobotanical data collection were semi-structured interviews, field observations, guided field walks, and group discussions with informants. A descriptive statistical method was applied to analyze and summarize the data. In the present study, a total of forty plant species representing twenty seven families were identified and documented to treat 33 human ailments. The most dominant plant part that used to prepare remedies was 22 (55%), followed by root 7(17.5%). The most common method of preparation is crushing 10 (25%) and the route of administration was oral 23 (57.5%).Euphorbiaceae was the most dominant medicinal plant family reported with 5 species. The result of the study also revealed Cordia africana as the most preferred multipurpose plant. The major factor reported as a threat to medicinal plants was deforestation (65%) followed by overgrazing by livestock (15%). This study confirmed that plants are still valued for their medicinal uses in the study area and the local community has rich indigenous knowledge of herbal medicinal plants. Since the plant species in the district are under high pressure, the concerned body should apply complementary conservation measures for sustainable use of herbal resources and to prevent species from extinction.

Keywords: Herbal medicine; Human ailments; indigenous knowledge; emedies; Traditional healers

Introduction

Ethiopia is known for its great topographical diversity which contributed to the formation of different ecosystems characterized by variations in biodiversity. The country also has flora that is extremely rich in its diversity and encompasses of more than 6000 vascular plant species with 10% endemic (Ensermu & Sebsebe, 2014, Siraj et al, 2016). Ethiopia is a country endowed with a huge potential of medicinal plants and their uses that provide a wide contribution to the treatment of human and livestock aliments practices in different regions (Gidayet al., 2003). Ethiopia has an enormous traditional knowledge of medicinal plants and has developed various ways to fight diseases through it.

Indigenous people have accumulated local knowledge on plant resource and their uses that have been developed for millennia. Medicinal plants are plants which contain inherent active components tending to relieve pain or cure disease's (Chama, 2017). Studies on survey of herbal medicinal plants are often significantly important in revealing local essential plant species particularly for the discovery of

medicines for treatment of human and animal diseases (Teklehaymanot & Giday, 2007). Traditional herbal medicine practitioner consists of knowledge systems that have developed over generations within various societies before the era of modern medicine. These, knowledge mostly transmitted orally through communities, families and individuals (Amare, 1976). Herbal medicines are used across the globe as it is dependent on locally existing and available plant resources, which are simply accessible, simple to use and affordable (Kebebew & Mohamed, 2017). The uses of plant species as herbal medicine by local communities represent by far the prime human use in terms of number of species of the natural world (Hamilton, 2003).Herbal medicine is the oldest form of health care in the world and is used in the prevention, and treatment of physical and mental illnesses (Yuan et al, 2016).

The local communities in many developing countries depend on plant based medicines even today, Moreover; the modern system of health care is mainly dependent on plant based ingredients (Srithi, 2009). According to Sofowora et al.,(2013), the majority over 90% of traditional medicine remedies/ recipes/contain medicinal plants. In developing countries, medicinal plants are used as a primary means of tackling different human and livestock diseases. Medicinal plants have vital role in the healthcare system for the majority of the rural communities in developing countries, as the major source of medicine and there is no exception for Ethiopia (Moges & Moges., 2019). In Ethiopia, about 800 species of plants are used in the traditional health care system to treat nearly 300 mental and physical disorders (Awas & Demissew, 2009, Hanshaet al., 2020). According to Mahmud and Malik, (2012), the main reasons in preferring herbal medicine to the modern one is because of easy accessibility, efficacy and affordable in getting health services. In many regions of the globe particularly in developing countries, herbal medicinal plants have not been well studied, documented or tested.

Ethnobotanical research describes the plant parts used for medicine, whether flowers, roots, leaves, branches /stem, or whole plant and how they are used(Cotton, 1996). .The concept of ethnobotanical knowledge has originated from indigenous people, which has the potential to redress some of the inadequacy of contemporary Western knowledge (Martin, 1995; Berkes, 1999).

In Ethiopia, indigenous communities of different ethnic groups have used plants as a source of medicine and have shown remarkable and effective medicinal values. In the country 80% of the population rely on about 800 species of plants in the traditional health care system, to treat about300 physical and mental disorders, and remains to be the major resource of treatment (Teklehaymanot, 2009). Moreover, it is not widely used as it could be because the skills are fragile and not written in the form of document so¸ it is easily forgotten and as most of the medicinal plants knowledge in the hands of people and kept as a secret (Werner, 2001). Like many of the developing countries, medicinal plants have not been well studied and documented in Ethiopia.

Herbal medical practitioners tend to hide the identity of plants used for different ailments for fear of patronage should the patient learn to cure himself. Indigenous knowledge on remedies in many countries including Ethiopia, pass from one generation to the other verbally with great secrecy(Janssen, 1981), such secrete and crude transfer makes ethnomedicinal knowledge vulnerable to distortion and in most cases, some of the lore is lost at each point of transfer(Amare, 1976). The documentation of the traditional medicinal plants used by the people for some ailments of human and domestic animals in Ethiopia is limited compared to the extent of variety of cultures and the diversity of the terrain (Teklehaymanot, 2009). Efforts that have been made so far to document the associated traditional knowledge

and conserve medicinal plants in the country are not as they should be (Giday et al, 2009). Traditionally, plants have been extremely used in many societies, and are prevalent in African communities who lived in harmony with the natural resources for centuries without bringing any detrimental effect on the survival of the biodiversity (Bussmann, 2006). However, the survival and existence of indigenous people and their long-term accumulated knowledge faces challenges because of modernization, genetic erosion of plant and animal resources, low recognition to their knowledge and varied culture, loss of biodiversity (Almaz, 2001; Bussmann, 2006). Traditional people all over the world, through their indigenous knowledge know which plant species are threatened and get priority management Aumeeruddy &Shengji, 2003). The reason behind the current loss of herbal medicinal plants in Ethiopia is due to natural and anthropogenic factors that have led to the loss of essential indigenous knowledge associated with the plants.

In different parts of Tigray, medicinal plants have been used as herbal medicine to treat different human diseases(Kidane et al., 2018) and the people who live in these areas have traditional knowledge on use of medicinal plant species. In Tigray Regional State, like other regions of Ethiopia medicinal plants have not been well studied and documented. Most of the information is still in the hands of the traditional healers (Yirga, 2010)and knowledge of healers is either lost or passed to the next generation by the word of mouth (Chama, 2017, Yirga, 2010)..Therefore, the present study was conduct to document the indigenous knowledge and medicinal plants species used by traditional healers to treat different human ailments in the study area. The study focuses in identifying the part of plant used for medicinal purposes, their mode of preparation and ingredients added, route of application and diseases treated.

Materials and methods

Description of the study area

Hintalo Wajerat District is one of the 52 districts found in Tigray Regional State, Ethiopia. And it is found in Southeast Zone of Tigray and has 22 kebeles and of which Freweyni, Gonka and Hintalokebeles were where the study was carried out. The district is found 748km and 35km far from the capital city of Ethiopia (Addis Ababa) and capital city of Tigray Regional State (Mekelle) respectively (Ruo et al., 2018).The district covers an area of 193,309 hectares with an estimated population of 181,274.The study area is bordered on the south by the Southern zone, on the west by Samre district, on the north by Enderta district, and on the east by the Afar Regional State. The district is located 50Km away from Mekelle, capital city of Tigray Regional State, to the south direction in the main road of Mekelle-Addis-Ababa (Figure.1). The study area has an average altitude of 2425 m above sea level, The mean minimum, mean maximum and mean average monthly temperature of the District is 8.7, 26.8, 17.75C0respectively (NMSAE,2018). There is only one rainy season in Tigray, falling between the months of June and August. The amount of rainfall of the study area is variable; and on average about 634.88 mm of which more than 70 % the rainfall occurs in the month of July and August followed by a long dry season. HintaloWajerat Office of Planning and finance (2018), indicated that the total area of Hintalo Wajerat District is about 58.121 km2. The land form is a mountainous with clay soil. Majority of the local people depend on agricultural practices. The people in the study area mainly cultivate Barely, Wheat, Teff, Bean, Pea, Maize and Sorghum, and rear domestic animals.

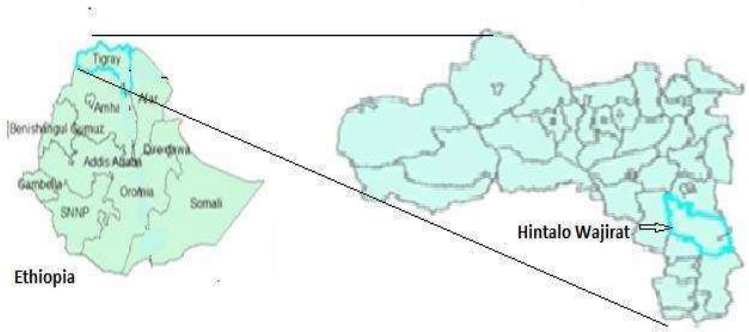

Figure 1 map of the study area Source: Taye Amssalu, 2005

Selection of study Kebeles and informants

Ethnobotanical data were collected between December, 2017 to April, 2018 from three kebeles that were purposively selected with the help of elders and local authorities of the District based on better availability of traditional healers and knowledgeable people. Based on recommendations from the elders and local authorities, 51 Informant healers were purposely selected to gather the relevant data.

Ethnobotanical data collection

A reconnaissance survey was first carried out to have an overview of the demographic, socio-economic and bio-physical conditions of the study area following Zenebe et al., (2012). The techniques employed in collecting ethnobotanical data were semi-structured interview, focus group discussion, field observation or guided field walks. These ethnobotanical techniques were employed to obtain medicinal plants of the locality, indigenous knowledge of healers, use, conservation and threats of the medicinal plants.

An interview was made with each traditional healer about the knowledge and use of medicinal plant species used to treat human aliments in the study area. Interviews were based on semi-structured checklist of topics consisting 18 questions prepared beforehand using Tigrigna (the local language of the community). Information regarding local name of medicinal plant, part(s) used, methods of gathering and preparation, disease treated, dosage used, route of administration, ingredients added, degree of management wild/cultivated were recorded. During survey, informants asked to mention or list the kinds of plants used as traditional medicine in the study area. The number of times a particular species mentioned by each informant was recorded. Sample plants of each medicinal plant species captured using photo camera during the field visits and allotted collection numbers.

Plant identification

Voucher specimens were collected for each plant species encountered with the exception of some very common cultivated plants, which were identified on the field. The collected plant specimens were pressed properly and then dried, and identified using the published volumes of the Flora of Ethiopia and Eritrea II-VIII and by comparing with authentic herbarium specimens and finally confirmed by taxonomist in Mekele University.

Ethnobotanical data analysis

The most useful ethnobotanical information gathered from the local healers during data collection were analyzed both qualitatively and quantitatively. Ethnobotanical information collected from the semi-structured interviews and field observation was computed by

preference ranking and direct matrix ranking following Martin (1995).

Direct matrix and preference ranking

Direct matrix ranking was exercised for seven commonly reported multipurpose medicinal plants in order to assess their relative importance to local people (Martin 1995).A group of six selected key informants were asked to assign use values for six plant species, based on their perceived level of usefulness using a numerical scale from 0 to five (0 = not used, 1 = least used , 2 = less used, 3 = good, 4 = very good and 5 = best) to each use category. Use categories in the comparison include medicine, fruit, fodder, fuel wood, construction, shade and fence.

Preference ranking exercise was conducted following Martin, (1995) by seven key informants on five medicinal plants used to treat tuberculosis in the District.

Results and discussion

Socio Demographic Characteristics of Respondents

The informants interviewed were in the age class of 23 to 65, but the majority of informants' age ranged among 43 to 65. In the present study, out of 51herbal medicine practicing informants, 36 (70.6%) males and 15 (29.4%) females were involved. The majority of the healers were illiterate 40 (78.4) and at most only able to read and write (4) while few (4) attended up to standard eight and the rest 3 had completed grade 12. The maximum number of years, that the traditional healers experienced ranges from 7 to 35.

The study revealed that informants above the age of 40 years had relatively better knowledge of medicinal plants as compared to the younger ones from 23 to 40 years old. During interviews and field visits, informants above 40 years of age were found to be very conversant on how to collect plants and process them. Besides, older informants had stronger belief in the curative effect of the medicinal plants as compared to the younger generation on medicinal plants reported and diseases treated.

The analysis of comparison of educational status revealed that, illiterate informants possessed much knowledge of traditional medicine than educated informants, which is an indicative of impact of modern education. This is in line with the study made by Oladele et al., 2011, which states, the highest percentage of younger generation had less knowledge of herbal medicine practice as they more exposed to modern education and life style. This may shows the impact of modernization on medicinal plant use and transfer of the associated knowledge to the younger generation.

Source of healing knowledge

The local people of the study area had traditionally accumulated knowledge on the use of traditional medicinal plants. According to the survey, knowledge transfer of medicinal plants follows vertical transfer to the most selected family members orally with great secrecy. The results of the interview revealed that majority of the informants obtained their knowledge of herbal medicine along the family line verbally, which accounts 30 (58.8%), followed by religious institutions 13(25.5%), by trial and error 6 (11.8%) and friends 2 (4%) (Table 1).This study is in line with a study of Reta, (2013), in which family were cited as source of knowledge. The majority of the informants 58.8% were willing to transfer their knowledge of herbal medicine along the family line verbally, while, other informants reported that they had no interest to transfer their knowledge at all.

Table 1.Source of healing knowledge in the study area

Source	Frequency	Percent (%)
Family	30	58.8
Religion	13	25.5
Trial and error	6	11.8
Friends	2	4

There are various ways of looking at the use of traditional medication and the interrelationships among humans. According to Melese (2001), plants are the major source of livelihood for the rural people of developing countries meaning that, no-plants-no-life. The informants from the local community stated that, indigenous knowledge about plants use has been a matter of survival to them, which agree with a report by Grenier, (1998). The knowledge is stored in indigenous social daily values that govern their being.

In the district the knowledge or information on the medicinal plants, was found in unwritten form and is considered as a secret. The result also revealed that members of the healers belonging to the age group above 40 years reported many medicinal plants while, those belonging to the age group between 23 and 40 years reported few medicinal plants. The result of this study showed that as people become older, their knowledge of traditional medicine becomes better. This is in line with a report of Giday, (2010) and Birhanu et al, (2015), which stated medicinal plant knowledge increases as age increases due to accumulation of knowledge through experience.

Medicinal plant species with their diversity and category

A total of 40 medicinal plant species belong to 27 families were collected and identified for treating 33 human ailments. Analysis of growth forms of these medicinal plants reveals that herbs constitute the largest category. The analysis of growth forms revealed that, herbs were represented by 14 species (35%), followed by trees and shrubs each represented by 12 (30%) and climbers were represented by 2 species (5%)(Figure2). Similar to this finding, a relatively higher number of herbs were previously reported elsewhere in Ethiopia; western Ethiopia (Debela, 2001; Tizazu, 2005;Amberberet al., 2014).The record of the highest number of herbs medicinal plant species in the study may be due to their relative abundance and accessibility in nearby areas as compared to other life forms.

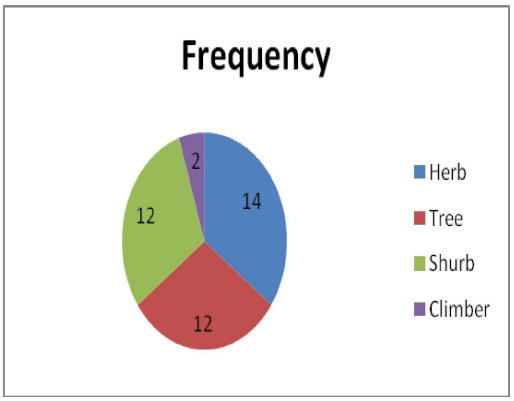

Figure 2.Habit of medicinal plants

In terms of family distribution in study area, Euphorbiaceae was the most dominant medicinal plant family reported with 5(12.5%)

species, followed by Solanaceae¸ Fabaaceae and Lamiaceae each with 3(7.5 %)species, Rutaceae, Polygonaceae and Moraceae 2(5%) species where as¸ the other remaining families were mono type species. Euphorbiaceae was also reported by other authors as the most dominantly used plant species to treated diseases (Jima &Megersa, 2018; Yinegeret al., 2008). This finding contradicts the results of other studies that were conducted in different parts of Ethiopia(Gebre, 2005; Gidayet al, 2009; Teklehaymanot et al., 2009; Gebrezgabiheret al., 2013;Birhanuet al, 2015). Majority of the medicinal plants 85% in Hintalo-Wajerat District were harvested from the wild. This result is in line with that of other studies reported elsewhere in Ethiopia (Giday & Ameni, 2003; Giday, 2001;Yinegeret al., 2008, Bekaloet al.,2009, Yirga, 2010).

Diseases treated by using traditional medicine

In the studyarea different ailments were recorded (Table 2). The indigenous communities were using traditional medicine to treat 33 human diseases. The local healers of the study area reported thatEucalyptus globules Lab ill¸Verbena officinalisL¸ Rutachalepensis L¸ RumexnervosusVahl¸Silenemacrosolen Steud. ex A. Rich were the most usable plant species.

Parts of medicinal plant used to treat human aliments

The plant parts used widely to treat human include leaves, roots, seeds, bark, fruits stems, and exudates (Figure 3). Leaves and root were the most commonly used plant parts in the preparation of remedies in the study District. The local healers of the study area mainly used leaves to prepare remedies20 (50%), followed by root 8(20%), seeds 3 (7.5%), bark¸ 2(5%), fruit3 (7.5%), stem 2 (5%), exudates2 (5%)(Figure 3).Many communities elsewhere in Ethiopia predominantly use leaves in the preparation of remedies, more frequently as compared to other parts of plants and this finding is in line with other studies made in elsewhere by (Abera, 2003; Giday &Ameni, 2003; Wassihun et al., 2003; Kala, 2005; Tadesse et al., 2005; Teshome, 2005; Ignacimuthu et al., 2006; Getaneh and Girma¸ 2014; Regassa et al., 2017). However, the findings of Hunde et al., 2006 and Teklehaymanot &Giday, (2007).indicated that traditional medicinal preparations mainly involve the use of roots.

Table 2.List of medicinal plants used to treat human diseases

Scientific name	Local name	Family	Habit	Source	Condition	Parts	Disease	Route of Administration	Method of preparation
Acacia etbaicaSchweinf.	Seraw	Fabaceae	T	W	Fr	S	Haemorrhoids	D	burn and place it on the affected part
Croton macrostachyusHochst. ex Delile	Tmbako	Euphorbiaceae	T	W	Dr/Fr	L	*Rabies*	O	leaves are crushed /squeezed and a cup of juice taken with honey
*Achyranthesaspera*L.	Mochale	Amaranthaceae	H	W	Fr	L	Tonsillitis	D	squeeze & put in head of child
*Allium sativum*Roscoe	Tsaedashngurti	Alliaceae	H	Cu	Fr	Se	cough	O	chew and swallow
*Aloe megalacantha*Bark	Ere	Aloaceae	Sh	W	Fr	Ex	Malaria	O	exudates, mixed with honey, is taken orally with coffee cup for three days
AlysicarpusferrugineusHochst. &Steud. ex A. Rich.	Hambohambo	Fabaceae	H	W	Fr	R	Jaundice	O	Exudates smeared on woundchew for five days
Azadirachtaindica A. Juss.	Limo	Melliaceae	T	W	Fr	L	Malaria	O	crush leaves, filter and drunk the juice
Beciumgrandiflorum (Lam.) Pic.Serm.	Tebeb	Lamiaceae	Sh	W	Fr	R	Black spider bite/Fire burn	O & D	chew and swallow the fluid
BosciasalicifoliaOliv	Sasa	Capparidaceae	Sh	W	Fr	L	Ear infection	E	leaves are crushed, squeezed and liquid filtered with clean cotton and three drops are applied on infected ear
Calotropisprocera (Aiton) W.T. Aiton	Gindae	Apocynaceae	Sh	W	Fr	L	Wound	D	crush and squeeze, rub affected part
*Chenopodiummurale*L	HamliKib'o	Chenopodiaceous	H	W	Fr	L	Dandruff	D	squeeze & cover affected area
Citrus sinesis (L.) Osbeck	Woyni	Rutaceae	Sh	Cu	Fr	F	Diabetes	O	juicing and drink
Commicarpuspedunculosus (A. Rich.) Cufod.	Eznianchewa	Nyctaginaceae	H	W	Fr	L	Leshimaniasis	D	squeeze and rub affected part
*Cordiaafricana*Lam.	Awhi	Boragenaceae	T	W	Fr	L	Febrile illness	O	leaves are crushed, squeezed and liquid taken with coffee
*Cucumisficifolius*Rich	Romborambo	Cucurbitaceae	C	W	Fr	R	Toothache and vomiting	O	Chew part with the diseased teeth Crush and drink the fluid

*Daturastramonium*L.	Mestenagr	Solanaceae	H	W	Fr	L	Tetanus	D	leaves are crushed, mixed with butter, heated and smeared on affected area before covering it with clean cotton cloth
*Dodoniaangustifolia.*Lf.	Tahses	Sapindaceae	T	W	Fr	L	Herpes zoster/ almazbalachira	D	burn, powder, add fresh butter then rub affected part
Dovyalisabyssinica A. Rich.) Warb.	Mengolhats	Flacourticeae	Sh	W	Fr	F	Abdominal pain	O	chew and swallow the fluid
*Eucalyptus globulus*Labill	Tsaedabaharzaf	Myrtaceae	T	Cu	Dr/Fr	L	Body infection	D	Heating & rash the skin
Euphorbia candelabrum Trémaux ex Kotschy	Kolkal	Euphorbiaceae	T	W	Fr	Ex	Tuberculosis	O	drinking the liquid
Euphorbia tirucallii L.	Kinchib	Euphorbiaceae	Sh	W	Fr	L	Wart	D	cut(bleeding) rub the affected part
*Ficuspalmata.*Forssk.	Beles	Moraceae	T	W	Fr	L	Haemorrhoids	D	crash & rub affected part
Ficusvasta.Forssk.	Daero	Moraceae	T	W	Fr	Ba	Ascariasis	O	crush and drink it with honey
*Linumusitatissimum*L.	Entatie/telba	Linaceae	H	Cu	Dr	Se	Placental retention	O	seeds roasted on iron sheet and grinding into powder, then cooked in the presence of honey and taken for a month before delivery
MeriandradiantheraRoth,ex. Roem. &Schult.)Briq.	Mesaguh	Lamiaceae	T	W	Fr	L	Blood pressure	O	leaves are boiled in water and solution taken daily for a month by cup of tea until improvement
*Otostegiaintegrifolia*Benth	Chiendog	Lamiaceae	Sh	W	Dr	L	Insecticide &Fleas	N	smoke for insictscide and a bunch of branch was burned and fumigated the room for 3-5 consecutive hours for Fleas
PhytolaccadodecandraL' Herit	Shebti	Pytolaceae	Sh	W	Dr	L F R	Rabies, Abortion, Itchy, abdominal pain	O	Dried root of the plant is powdered and mixed with local alcohol and a cup of solution drunk daily for twelve days. vomiting is its side effect and ,therefore ,restricted to children and pregnant women
*RicinusCommunis*L.	Engule	Euphorbiaceae	Sh	W	Dr	F	Amoebiasis	O	crushed seeds are mixed with water and taken with a cup of tea once
*Rumexabyssinicus*Jacq.	Mekmako	Polygonaceae	H	W	Dr	R	Tuberculosis	O	chewing the root
*Rumexnervosus*Vahl.	Hahot	Polygonaceae	Sh	W	Fr	L	Skin rash	D	leaves are crushed and paste rubbed on affected area
Rutachalepensis L.	Chena adam	Rutaceae	H	Cu	Fr	L	Cough	O	leaves boiled in milk are taken orally
Silenemacrosolen.Steu	Saerisaero	Caryophyllaceae	H	W	Dr	L	Snake repulsion	N	Place it on fire for fumigation smoking

Ex A. Rich									
Solanummarginatum Linn. f.	Engule(abyi)	Solanaceae	Sh	W	Dr	Se	Tuberculosis	O	dried, crushed and added into milk or coffee and solution taken every morning for 21 days
SolanummariginatumL.f.	Alalmokelbi	Solanaceae	H	W	Fr	L	Hepatitis	O	squeeze and drink the liquid
*Terminaliabrownie***Frese n.**	weyni	Combretaceae	T	W	Fr	Ba	Hepatitis	O	bark is boiled then drinking the decoction
Tragiacinerea (Pax) Gilbert &Radcl. Smith	Shashito	Euphorbiaceae	C	W	Dr	R	Impotence	O	roots are grounded and taken orally with local soup for week
Verbascumsinaiticum Benth.	Terneka	Scrophulariaceae	H	W	Fr	R	Tuberculosis	O	squeeze add butter/milk
*Verbena officinalis*L.	Atush	Verbenaceae	H	W	Fr	R	Tonsillitis	O	chew & swallow fluid
Vernoniaamygdalina Del.	Grawa	Asteraceae	T	W	Fr	L	Leg problem	D	leaf squeezed & rash the skin
*Viciafaba*L.	Ater	Fabaceae	H	Cu	Dr	Se	wound	D	powder & cover affected area for 5-7 consecutive days at the interval of one day

Notice H=herb, Sh=Shurb,T=Tree, O=Oral, D= Dermal,N= Nasal, E=Ear= Dr=dry, Fr- fresh,Cu= cultivated, W=Wild, Se= seed, L=leaf, Fruit, Ba=bark, ex=exudates, R=root=,S=stem

Preparation and mode of administration of remedies

The result of the study indicated that, the majority of medicinal plants were used in fresh form 29 (72.5%), followed by 9 (22.5%) dried form and 2 (5.0%) fresh or dry (table 3). This indicates that local community can pick the plant part any time of the year from their vicinity. Similar finding were reported elsewhere (Giday et al., 2003; Giday and Ameni, 2003; Bussmann& Sharon, 2006; Ignacimuthu et al., 2006).

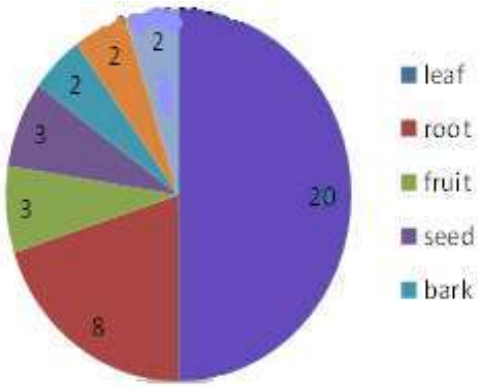

Figure 3. Parts of medicinal plants used

Table 3. Condition of preparation of the remedies

Plant condition	Percentage
Fresh	72.5
Dry	22.5
Fresh or Dry	5

The most widely used methods of medicinal plant preparation were through crushing, 10(25%), squeezing, 9 (22.5%), chewing, 5 (12.5%),powder, 4(10%) burning, 4 (10%), boiling,3 (7.5%),smoking, juicing and bleeding each2 (5%) (Fig.4).Similar results were also reported elsewhere (Tamene, 2000; Fisseha, 2007). Most of the medicinal plants used to treat ailments were mixed with other ingredients. The other ingredients were used to increase medicinal value of the remedies, reduce adverse effects such as vomiting and diarrhea, and enhance the efficacy and healing condition. The most commonly used additive by the healers was water, milk, butter, honey, coffee and tea. Informants of the study area reported that, some of medicinal plants need additional ingredients for aliment. The informants reported that, among 40 traditional medicinal plants 14 medicinal plants needs ingredients like, honey, coffee, water, butter, milk and among them, 2 (14.28%) are prepared with milk, 2 (14.28%) with butter, 2 (14.28%) with coffee, 2 (14.28%) with water, 4 (28.57%) with honey,1 (7.14%) local alcohol and 1 (7.14%) milk/ coffee. Most of the medicine prepared and mixed with ingredients administrated by oral 12 (85.71%) and 2 (14.29%) dermal.
Ethnobotanical studies conducted in different parts of the country reported similar results (Abdurrahman, 2010;Teshome, 2005; Getaneh & Girma, 2014).

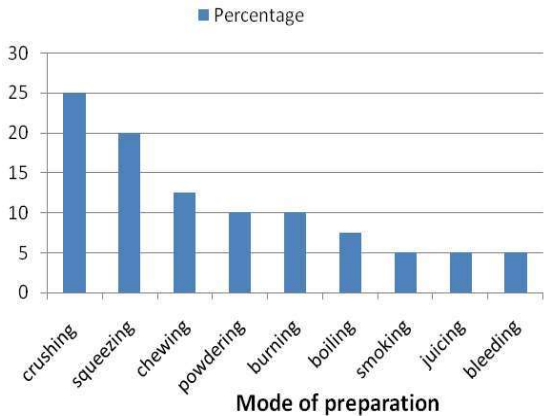

Figure 4.Traditional medicinal plant preparation in the study

The most frequently used route of administration is oral ingestion, which accounts for 23 (57.5%) followed by dermal 13 (32.5%) (Table 4).The oral route was most frequently used amd reported in many studies elsewhere (Giday et al., 2003; Macíaet al.,2005; Bekalo et al.,2009), This result is contrary to the study made by Teklay et al., (2013), in which dermal route of administration is the most frequently used.

Table: 4.Route of administration of traditional medicinal plants

Administration	Number of species	Percentage
Oral	23	57.5
Dermal	13	32.5
Nasal	2	5
Ear	1	2.5
Oral / dermal	1	2.5

Dosage and measurements of medicinal plants

Traditional medicinal plant practitioners of the study area used different measurement unit and duration to determine the dosage of medicine. Local units for instance, half cup, and full cup, finger length for bark, root and stem are used (table 5). Numbers of different parts of plants such as leaves, seeds, and fruits, shoot tip also used to estimate and fix the amount of dosage. The full dose determination varied from healer to healer, and the dose given depends on age, physical strength and health conditions. This finding indicated lack of precision and standardization as the main drawback for recognition of the traditional practice and it is line with the study made by (Sofowora, 1982; Abebe, 1993, Yirga, 2010).

Table 5.Common units of measurements of dosage used by local healers

Prepared remedies	Units (measurements)
Root	Finger length
Seed	Number
Leaf	Number
Powder	Tea spoon
Liquid	Cup

Direct matrix and preference ranking

Direct matrix ranking was performed (Table 4) following the method of Martin, (1995) to medicinal plant species for their multipurpose use and to relate this to the extent of its utilization versus its dominance.

Result of direct matrix ranking conducted by nine key informants on six selected multipurpose medicinal plants showed that *Cordia africana* as the most preferred multipurpose plant, followed by *Eucalyptus globules, Dodonia angustifolia. Lf., Croton macrostachyus Hochst.exDelileand Vernonia amygdalinaDel* (Table 6). Showing multipurpose roles and the most preferred and extensively exploited by the local community.

Similar studies were carried out elsewhere in other parts of Ethiopia like in GantaAfeshum District, Eastern Zone of Tigray, Northern Ethiopia (Kidane et al., 2018) and Goma Wereda, Jima Zone of Oromia Region, Ethiopia, by (Etana, 2010) in which both used the method of direct matrix ranking and revealed that *Cordia africana* was the most preferred and first ranked multipurpose plant species.

Informants' preference on medicinal plants used to treat tuberculosis

The informants' simple preference ranking for 5 medicinal plants that was used to treat Tuberculosis in Hintalo Wajerat District is shown in (Table 7). The result of ranking indicated that Verbascumsinaiticum Benth scored the highest mark and subsequently it was graded first, where as Euphorbia candelabrum Trémaux ex Kotschy, Solanum marginatum Linn. f., Rumex abyssinicusJacq.,RicinusCommunisL. scored second to the fifth rank, respectively, for the efficient treatment of tuberculosis.

Table 6. Direct matrix ranking exercise on five multiple purpose medicinal plants

Species use categories	***Cordia africana*La m.**	***Croton macrostachyus*Hochst.ex.Delile**	***Eucalyptus globules* Labill**	***Acacia etbaica* Schweinf.**	***Vernonia Amygdalina* Del.**	***Dodonia angustifolia.* Lf.**
Charcoal	3	5	1	5	3	4
Fuel wood	5	4	5	4	4	5
Construction	4	4	5	3	4	4
Medicine	3	4	5	3	4	4
Shade	5	2	5	4	2	3
Edible Fruit/food	5	0	0	0	0	0
Furinture	4	4	4	2		4
Total	29	23	25	21	17	24
Rank	1st	4th	2nd	5th	6th	3rd

Table 7. Preference ranking by seven respondents to medicinal plants used for treating tuberculosis in Hintalo Wajerat District,Tigray,Northen Ethiopia

Lists of medicinal plants	**Informants**								
	R1	R2	R3	R4	R5	R6	R7	Total	Rank
***Solanummarginatum* Linn. f.**	5	3	4	4	3	4	5	28	3rd
***Verbascumsinaiticum* Benth.**	5	6	5	5	4	4	5	34	1st
***Rumex abyssinicus*Jacq.**	4	3	4	4	3	3	5	26	4th
***Euphorbia candelabrum* Trémaux ex Kotschy**	3	4	4	4	5	5	5	30	2nd
***RicinusCommunis*L.**	4	2	4	4	4	3	4	25	5th

Threats of medicinal plants and conservation practices in the study area

Medicinal plants are at increasing threat from destruction of their habitats (firewood collection, agricultural activities, collecting plants for construction, urbanization, overgrazing by domestic animals) and over-harvesting. Like other parts of Ethiopia, the vegetation of the study area is threatened by several factors. In HintaloWajerat District various factors were considered as main threats for medicinal plants which were recorded during the discussion with the informants. Accordingly, the major factors reported were deforestation (65%), overgrazing (15%), for construction (13%) and source of fuel (7%). Informants frequently cited deforestation became as the most threatening factor on medicinal plants and this is line report made by other researchers Giday, (2001) and Mesfin et al., (2009).

People of the study area know the benefits of conserving medicinal plants. However, the effort of conserving medicinal plants is very restricted. This study revealed that many of the informants who have knowledge on traditional medicine usage give priority to the immediate use of the medicinal plants than to its sustainable future uses, as a result, their harvesting style is destructive. Most of plant species reported in the study area 34 (85%) were collected from the wild while, the remaining part¸ 6(15%) were collected from the home garden. The result of this finding is in line with the general patterns seen in most medicinal plants inventory studies such as that of Tamene, (2000) and Abera, (2014). It was found that only6(15%) of the medicinal plant species were obtained from the homegarden, this shows most of the herbalists are not ready to grow medicinal plants in their home garden for future sustainable use, this is in agreement with other studies conducted elsewhere in the country Abdurhman, (2010), Giday et al., (2003) and Yineger et al., (2008).

Conclusion

The traditional health care practice of the local community in the study area is mainly dependent on medicinal plants collected from the wild. Plant species are the potential sources of medicine in primary healthcare systems of the local community in Hintalo Wajerat district. In the present study, forty plant species of medicinal importance, used to treat thirty three human diseases were recorded and documented. This study also showed that plants are still valued for their medicinal purposes in study area.

The majority of Medicinal plants are applied orally via drinking its juice, eating its root, barks, stem, leaf, seed, fruit, where as others used dermal by applying on the affected part of human body. Each plant and plant part has its own preparation method and route of administration. The most common method of preparation is crushing 10 (25%) and the route of administration was oral 23 (57.5%). It is possible to conclude that older traditional healers had greater knowledge and use of ethnomedicinal plant species compared to the younger traditional healers. Medicinal plants were suffering from the threats of deforestation, overgrazing by livestock, collection of plant material for firewood and construction. Despite this fact, there is little effort in the District to cultivate or mange medicinal plants. Thus awareness is needed be raised among local people on sustainable utilization and management of the plant resources.

Acknowledgments

The authors would like to thank Ambo University for financial support and the Traditional Medicinal Practitioners (informants) for their respect, hospitality and kind response to the inquiries on the information regarding medicinal plants.

Conflict of interest

The authors declare no conflict of interest related to this paper

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Journal of Science and Sustainable Development (JSSD), 2021, 9(2), 18-30

ISSN: 2304-2702 (print); 2414-4479 (online)
DOI: _10.20372/au.jssd.9.2.2021.0330 [18]

RESEARCH PAPER

Effect of Different Types of Foreign Direct Investment on Economic Growth: Panel Data Analysis

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Abstract

This study examined whether different types of foreign direct investment have different effects on economic growth. Specifically, it examined if the different types of foreign direct investment could complement or could displace domestic investment in Sub-Saharan Africa vs. in rest of the world. The study utilized panel data from 142 (36 Sub-Saharan Africa and 106 others) countries over the period of 2003-2017. Possible endogeneity bias was addressed using generalized method of moment estimator. The study revealed that intensive margins of Greenfield foreign direct investment and cross-border merger and acquisition influence economic growth in rest of the world. In Sub-Saharan Africa, however, only extensive margin of Greenfield foreign direct investment is robustly influencing economic growth. The study further identified that Greenfield foreign direct investment margins might displace domestic investment while cross-border merger and acquisition margins could complement domestic investment in rest of the world. In Sub-Saharan Africa, nonetheless, the study reveals that only extensive margin of Greenfield foreign direct investment robustly complements domestic investment. Therefore, Sub-Saharan Africa countries such Ethiopia could directly promote their economic growth by attracting larger numbers of Greenfield foreign direct investment projects rather than inviting foreign direct investment with intensive investments in a few projects. Policies that augment human capital and promote domestic investment could help Sub-Saharan Africa countries to accelerate their economic growth with the help of Greenfield foreign direct investment..

Keywords: Foreign direct investment, Greenfield, intensive margin, extensive margin, endogeneity

Introduction

In 21st century, we live in a highly globalized world and globalization has become an inevitable phenomenon. The ever increasing interdependences among economies have been deepened by increase in international trade flows, international migration and international investment in the form of foreign direct investment (FDI). The interdependences among economies have been supported by enormous improvement in information and communication technology (ICT) and advancement in transport facilities. Domestic, regional and international level reforms have also accelerated the interconnectedness among countries as documented in Garas, Lapatinas and Poulios (2016).

Literature in the field of international economics has well documented the pros and the cons of globalization. However, there are a lot of outstanding issues as how different aspects of globalization process influence economic growth. The focus of this study is on FDI-growth nexus. The reason is that global FDI flows have surpassed even international

trade flows in recent years and has become the major channel that link economies across borders. For example, Blonigen (2005) argues that multinational enterprises (MNEs) activity in the form of FDI has been growing at a faster rate than most of the other international transactions.

As per African Union Commission/OECD (2018), between 2000 and 2016, Africa has registered impressive annual economic growth averaging 4.6% well above Latin American and Caribbean (2.8%) but less than developing Asia (7.2%). It is, therefore, interesting to identify factors contributing to this impressive growth in Africa focusing on Sub-Saharan Africa (SSA). The current study intends to see the effect of FDI on economic growth since FDI flows has been surging over the last decades.

There are two types of FDI modes: Greenfield FDI and cross-border merger and acquisition. While Greenfield FDI involves construction of new facilities, cross-border merger and acquisition is combinations of two or more companies that aim to attain strategic objectives. This means that greenfield FDI involves constructing a new company in a host country from the foundation. Cross-border merger and acquisition, however, includes either acquiring an existing company entirely or purchasing certain shares of a foreign company (Chala and Lee, 2015). In addition it is interesting to examine the effects of FDI margins on economic growth. There are two types of FDI margins. The first one is an extensive margin, which refers to the number of Greenfield FDI or cross-border merger and acquisitions projects counts. The second one is an intensive margin, which refers to how much value invested per Greenfield FDI or cross-border M&A investment project.

Intuitively, there are a number of pathways through which FDI could influence economic growth in a host country. First, FDI in the form of Greenfield investment greatly contributes to a host country's economic growth since it contributes to expanding the host country's capital stock (Ghazanchyan and Stotsky, 2013). Second, cross-border merger and acquisition could affect economic growth since it often affects total factor productivity (TFP) as documented by Ashraf et al. (2016). Thirdly, FDI may exert a positive influence on local investment, perhaps because the attraction of complementary activities could dominate the displacement of local competitors. This is an indirect effect of FDI on economic growth since local companies sometimes provide inputs utilized by multinational enterprises (MNEs) themselves. Fourth, FDI may stimulate domestic investment and encourage improvements in human capital and institutions in countries that host FDI. This is because FDI may complement domestic capital formation and MNEs often utilize better technology that requires advanced knowledge. The local firms strive to improve their efficiencies to survive competitions (Farole and Winkler, 2014).

Theoretical arguments present conditions required for FDI to have a positive effect on economic growth. For example, Benhabib and Spiegel (1994) and Nelson and Phelps (1966) contend that countries which host FDI should have a certain level of an absorptive capability as a requirement for FDI to promote their economic growth. This suggests that human capital and FDI are complementary in the process of economic growth. Another theoretical notion states that FDI may complement or displace domestic investment. Crowding-out effect could be possible since MNEs may compete for financial resources, product and/or resource markets with local companies and then displace them out. To the contrary, a possible crowding-in effect of FDI on economic growth may happen. This is because FDI may favor domestic companies to flourish by complementing them in production or enhancing their efficiencies via advanced technology spillover effects. For example, Findlay (1978) claims that FDI increases technological progress in a host country through spillover effect from latest technology, best management practices, and efficient production technique used by MNEs in countries which host FDI.

From empirical viewpoints, there are many studies, which investigate the effect of FDI on economic growth. However, FDI-growth nexus has been inconclusive. In addition, there are

limited research works that attempt to examine as how different types of FDI modes (Greenfield vs. cross-border merger and acquisition) and FDI margins (number of investment project counts) affect economic growth. The channels through which these different modes and margins of FDI affect economic growth are not well documented particularly in Sub-Saharan Africa. Studies that decompose FDI into Greenfield and cross-border merger and acquisition argue that only greenfield FDI affects economic growth (Ghazanchyan and Stotsky, 2013). These all mixed findings justify the need to undertake a comprehensive study in the area of FDI-growth nexus.

Using cross-country data for the period 1981-1999, Alfaro (2003) concludes that total FDI exerts an ambiguous effect on economic growth. The author argues that the sector in which investment is undertaken matters most. According to the author, FDI in primary sector seems to have a negative association with economic growth while FDI in manufacturing sector has a positive association with economic growth. The author further contends that the effect of FDI in service sector is ambiguous. Similarly, using a panel of 58 countries over 1980-2004, Noormamode (2008) finds that there is no clear-cut evidence on FDI-growth nexus.

Likewise, Alfaro et al. (2003) examine the role of financial markets in FDI-economic growth association. The authors find that well developed financial market allow significant gain from FDI while FDI alone has an ambiguous effect on economic growth. This contradicts with a finding by Behname (2012) which concludes that FDI has positive and statistically significant effect on economic growth in Southern Asia countries for the time period 1977-2009. Nevertheless, the study has not decomposed FDI into greenfield and cross-border border merger and acquisition. Neither the study examines the effects of the extensive vs. intensive margins.

In a related study, Alfaro et al. (2006) contend that local financial markets play an enabling role for FDI to stimulate economic growth through backward and forward linkages. The authors further argue that local conditions such as market structure and human capital are important for the effect of FDI on economic growth confirming the theoretical notion which states that some conditions shall be satisfied for FDI to contribute to economic growth.

More interestingly, other studies disaggregate FDI into greenfield FDI and cross-border M and A. For instance, Calderón et al. (2004) argue that in both developed and developing countries, both modes of FDI lead domestic investment but not the reverse. Furthermore, the authors find that both FDI modes do not appear to precede economic growth in either developing or developed economies. However, the authors argue that FDI responds positively to economic growth. In related study, Harms and Méon (2014) find that only greenfield investment contributes to economic growth of host countries as it adds to the countries capital stock. However, the authors argue that cross-border merger and acquisition simply involves rent accumulating to previous owners and hence contributes less to economic growth of host country.

In a similar way to Calderón et al. (2004), Ashraf et al. (2016) examine the effect of greenfield investment and cross-border merger and acquisition on TFP in developed and developing countries hosting FDI. Utilizing panel data from 123 countries for the time period 2003-2011, the authors find that greenfield FDI has no statistically significant effect on TFP while cross-border M and A has positive effect on TFP. They argue that both greenfield FDI and M and As appear to be ineffective in increasing TFP in the sub-sample of developing countries. Nevertheless, merger and acquisition has a strong and positive effect on TFP in the sub-sample of developed countries.

Focusing on China, which has become top among emerging economies in terms of attracting FDI inflows, Tuan et al. (2009) investigate the association between FDI and productivity growth. By addressing endogeneity of TFP and the simultaneous relations of FDI in affecting TFP and economic

growth, the authors find that FDI exerts spillover effects and affects TFP growth of the host countries. Their finding contrasts the finding documented by Ashraf et al. (2016).

By using dynamic simultaneous–equation model, Omri et al. (2015) investigated causality links between FDI and economic growth in panel of 54 countries covering different regions of the world. The authors find bidirectional causality between FDI inflows and economic growth. In a related study, however, Abbes et al. (2015) find a different result as compared to Omri et al. (2014). By considering 65 countries, the authors find unidirectional causality running from FDI to GDP. The authors argue that the unidirectional association running from FDI to economic growth may help countries allocate resources to attract FDI inflows.

In another yet related study, using Generalized Method of Moment (GMM) estimator, Hong (2014) evaluates the effects of FDI on economic growth in China for the period 1994-2010. By utilizing data from 254 Chinese cities, the author finds that FDI exerts positive impact on economic development in China. The author further argues that FDI influences economic growth via economies of scale, level of human capital, and level of wage.

Azman-Saini et al. (2010) uses cross-country data from 91 countries over the time period 1975–2005. The study utilized a threshold regression model and finds that the positive impact of FDI on economic growth exists only after financial market development exceeds a threshold level. The authors argue that until then the effect of FDI on economic growth is non-existent.

Some studies argue that the relationship between FDI and economic growth may vary from country to country. For example, Moudatsou (2003) find that only past FDI inflows have a significant effect on economic growth in European Union (EU) countries. The author further finds that FDI has both direct and indirect (via trade reinforcement) effect on economic growth in EU member countries. The author also argues that the effect of FDI on economic growth is conditional upon the level of human capital in developed countries hosting FDI. Likewise, Noormamode (2008) argues that the nature of FDI-growth relationships could vary based on the income level of countries.

Feeny et al. (2014) examine the effect of FDI on economic growth in the pacific region. The authors find that higher FDI inflows are associated with higher economic growth in the region. However, the study argues that the impact of FDI on economic growth is lower in Pacific countries than it is in other countries hosting FDI. This fining implies that effect of FDI on economic growth may vary from region to region. Similarly, Nistor (2014) argues that the impact of FDI on economic growth in countries hosting FDI depends on area and region of hosting countries. The author contends that quality and quantity of FDI may also matter.

In a very recent study, Bouchouch and Ali (2019) examine short and long run relationships between FDI and economic growth using time series data for Tunisia over the time period 1980-2015. The authors find that FDI has positive effect both in the short and long run.

Focusing on SSA, Adams (2009) investigates FDI, domestic investment and economic growth for the period 1990-2003. The author finds that FDI has an initial negative effect on domestic investment and subsequent positive effect in the later periods. The author contends that FDI could crowds-out the domestic capital formation. Similarly, Ijirshar et al. (2020) utilize a dynamic panel model to investigate growth- differential effects of FDI and domestic investment. The author finds that both FDI and domestic investment are important for economic growth in the long run. The author further documents that FDI crowds-in domestic investment in Africa.

This study aims to address the above gaps in the following ways. First, the study examines whether extensive and intensive margins of greenfield FDI and cross-border merger and acquisition affect economic growth differently.

Second, the paper examines if SSA is unique pertaining to the effects of different types of FDI on economic growth is concerned. Third, the study analyses whether attaining certain thresholds of human and/or physical capital are indeed a requirement for FDI to influence economic growth in SSA. Finally, the study tests whether the different types of FDI modes and margins crowds-out or crowds-in domestic investment in the process of economic growth in rest of the world vs. SSA..

Estimation strategy, the data, and procedures of data interpretation

Following Mankiw *et al.* (1992); Barro and Sala-i-Martin (1995), the standard neoclassical-growth model could be derived from Cobb-Douglas production function given by:

$$Y(t) = K(t)^{\alpha}H(t)^{\beta}\{A(t)L(t)\}^{1-\alpha-\beta} \ldots\ldots\ldots(1)$$

Where $Y(t), K(t)$, $H(t)$ and $L(t)$ denote respectively GDP, physical capital; human capital and labour at time t; α and β are partial elasticities of output with respect to capital and labour respectively. $A(t)$ denotes the level of technology or efficiency. Here, the production function is assumed to exhibit constant returns to scale. Taking the natural logarithm of both sides of equation (1), we get the bench mark growth equation. By introducing cross-section dimension (i) and times series dimension (t), we obtain panel data model specification:

$$Y_{it} = \emptyset + \alpha lnK_{it} + \beta lnH_{it} + (1-\alpha-\beta)(lnA_{it} + ln\,L_{it}) + \varepsilon_{it}$$

…… (2)

Where ε_{it} is an error term such that $\varepsilon_{it} \sim N(0, \sigma^2)$ and $\emptyset$ is constant term. Augmenting equation (2) and following Edwardo *et al.* (1998), the model to be estimated take the following form:

$$lnGDP_{it} = \beta_0 + \beta_1 lnFDI_{it} + \beta_2 HC_{it} + \beta_3 \ln(HC_{it} * lnFDI_{it}) + \beta_4 \ln(lnDIV_{it} * lnFDI_{it}) + \beta_5 lnZ_{it} + \mu_t + \gamma_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where GDP_{it} is of GDP of country i in year t; FDI_{it} denotes foreign direct investment in the form of greenfield FDI or cross-border merger and acquisition of country i in year t. FDI_{it} also denotes intensive margin or extensive margin of greenfield FDI or cross-border merger and acquisition alternatively. HC_{it} stands for human capital (year of schooling) of country i in year t; DVI_{it} denotes domestic investment for country i in year t; Z_{it} denotes other control variables often included in growth equations such as government size; freedom to internationally trade, sound money, legal system, property right, openness of county i in year t. μ_t represents time-fixed effect that captures country characteristics that do not vary cross-sectionally but vary overtime. Incorporating time fixed effect accounts for global business cycle in the form of booms and recessions that may affect economic growth in host countries. γ_i denotes regional heterogeneities which do not vary overtime but vary from regions to regions.

The data utilized in this research are compiled from different sources such as World Bank Data base; United Nations Conference on Trade and Development; Pen World Table 9.1)

The techniques and data analysis procedure utilized in the current is based on our model specification and as how the variables, that is, the dependent and independent variables enter the model. As shown in equations (1), we started from Cobb-Douglass production function. In equation (2), we have transformed the model into double logarithms in order to linearize the coefficients. Consequently, we interpret the coefficients as elasticities. In equation (3), we have augmented the model by incorporating different modes (greenfield and cross-border merger and acquisition) and margins of the two modes of foreign direct investment. In addition, we have interacted

domestic investment with modes and margins of foreign direct investment to test whether foreign direct investment crowds-in or crowds-out domestic investment in the process of economic growth. Likewise, we have interacted human capital with the modes and margins of foreign direct investment to examine the role of host countries' human capital in economic growth-foreign direct investment nexus.

To address the objectives of the study, this section focuses on examining the effects of different types of FDI modes and margins on economic growth. In addition, the study is interested to analyze whether FDI displaces or complements domestic investment. The study farther aims to test whether countries in SSA Africa are different from the rest of the world in FDI-growth nexus.

Results and discussion

Table 1: Margins and Modes of FDI and Economic Growth: RoW vs. Sub-Saharan Africa Using Fixed Effects Estimator

	Rest of the World				Sub-Saharan African Countries			
Dependent variable: GDP^$_{it}$	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 6	Model 6
Greenfield intensive$_{it}$^	0.014*				0.022*			
	(0.008)				(0.013)			
Greenfield extensive$_{it}$^		0.012				0.041*		
		(0.013)				(0.022)		
M&A intensive$_{it}$			0.016***				0.012	
			(0.004)				(0.012)	
M&A extensive$_{it}$^				0.017				0.009
				(0.010)				(0.021)
Human capital $_{it}$	0.198**	0.174**	0.183**	0.145*	-0.023	0.038	-0.380	0.050
	(0.077)	(0.076)	(0.081)	(0.077)	(0.244)	(0.235)	(0.371)	(0.246)
Property Right^$_{it}$	0.261***	0.256***	0.261***	0.256***	0.168***	0.158***	0.258***	0.165***
	(0.022)	(0.022)	(0.024)	(0.022)	(0.050)	(0.049)	(0.070)	(0.050)
Sound money$_{it}$	0.014	0.018**	0.018*	0.019**	-0.026	-0.032*	-0.043	-0.036*
	(0.009)	(0.009)	(0.010)	(0.009)	(0.019)	(0.018)	(0.033)	(0.019)
Freedom to globally trade$_{it}$	0.018	0.014	0.024	0.018	0.040	0.035	0.068	0.046
	(0.014)	(0.014)	(0.017)	(0.014)	(0.032)	(0.031)	(0.044)	(0.033)
Size of government$_{it}$	-0.008	-0.008	0.002	-0.009	0.045	0.034	0.027	0.039
	(0.013)	(0.013)	(0.014)	(0.013)	(0.030)	(0.029)	(0.041)	(0.031)
Legal system$_{it}$	0.027*	0.021	0.025	0.017	0.122**	0.133***	0.102	0.134***
	(0.016)	(0.016)	(0.017)	(0.016)	(0.048)	(0.046)	(0.064)	(0.048)
Openness$_{it}$	-0.428***	-0.430***	-0.434***	-0.435***	-0.627***	-0.624***	-0.625***	-0.618***
	(0.043)	(0.042)	(0.046)	(0.043)	(0.144)	(0.140)	(0.209)	(0.145)
Constat	21.989***	22.111***	22.059***	22.214***	21.043***	21.103***	21.402***	21.010***
	(0.341)	(0.336)	(0.371)	(0.342)	(0.726)	(0.682)	(1.132)	(0.715)
Year Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1150	1165	963	1146	175	190	118	184
R-sq	0.795	0.794	0.793	0.793	0.851	0.850	0.855	0.849
rmse	0.162	0.162	0.159	0.161	0.137	0.136	0.139	0.139

Note : 1. Standard errors in parentheses
2. Significant variables are denoted by ***, ** and * at 1%, 5% and 10% respectively
3. ^ denotes that the variables are in their natural logarithmic form

First, the paper examines if FDI modes and margins have a direct effect on economic growth. The empirical results on the direct effects of different types of FDI modes and margins on economic growth are presented in Table 1. For comparison purpose, countries are grouped into two sub-samples, namely, RoW vs. SSA. As summarized in Table 1 under Models 1 and 3, intensive margins of both greenfield FDI and cross-border M and A enter the models with positive and statistically significant coefficient at 10% and 1% respectively. Specifically, 1% increase in intensive margin of greenfield FDI is associated with 0.014% change in economic growth rest of the world. Likewise, 1% increase in the intensive margin of cross-border M and A leads to 0.016% change in RoW. The results are consistent with a finding by Luu (2016) which argues that both greenfield FDI and cross-border M&A have positive effect on economic growth in emerging countries. However, the author has not distinguished extensive margins from intensive margins. This implies that intensive margins of greenfield investment and cross-border M&A are more important in influencing economic growth than their extensive margins in rest of the world.

The positive effect of greenfield FDI on economic growth is also consistent with a finding by Hong (2014). As per the author, economies of scale, human capital; infrastructure and wage level are pathways through which FDI promotes economic growth in China. The author, however, argues that FDI may likely displace domestic capital formation.

When the sub-sample of countries are limited to SSA, both extensive and intensive margins of greenfield FDI enter the models with statistically significant and positive coefficients. Explicitly, 1% increase in intensive and extensive margins of greenfield FDI is associated with 0.022% and 0.041% change in economic growth. The finding is intuitively appealing since greenfield investments undertaken by MNEs often bring in latest managerial knowledge and advanced technology which often spillover to local companies thereby promoting economic growth in countries hosting FDI. Besides, it specifically adds to host countries' capital stock. This empirical result supports the finding by Harms and Méon (2014) though authors have not considered extensive margin of greenfield FDI but focused just on aggregated value of greenfield FDI.

The finding that extensive margin of greenfield FDI has positive association with an economic growth process in SSA also sounds well (See Tables 2, 3 and 4). This is because having larger number of investment projects could be considered as diversification that increases the probability of project success in developing regions such as SSA which are characterized by a lots of country risks. This is in line with the argument advanced by Keller and Yeaple (2009b) which contend that substantial technology spillovers from FDI occurs only when the diversification of multinational affiliates is accounted for in their FDI activities.

Furthermore, larger numbers of project counts cover larger areas increase the chance to fairly distribute benefits generated by FDI. This in turn could contribute to reduce income inequality which often paves way for sustainable economic growth. The positive association between greenfield FDI in SSA once again reinforces the finding by Luu (2016); Harms and Méon (2014) though the authors have not distinguished extensive and intensive margins as discussed earlier.

The direct effect of greenfield FDI on economic growth in SSA is consistent with our expectations This is because countries in SSA often lack complementarities such as high level of human capital and domestic investment often considered as requirements for countries to benefit from FDI inflows. Thus, countries in SSA could directly accelerate their economic growth with the help of greenfield FDI even if they do not have the required human capital and domestic investment at the inception. The possible reason for this direct effect could be because soon after MNEs start constructing new facilities, worker starts acquiring the required human capital hoping that you can get job in this business. By the time the construction of the facilities is completed, the

labourers have already acquired the needed human capital. This helps the MNEs to operate efficiently without any delay. Studies such as Luu (2016); Alfaro et al. (2006) argue that certain threshold of human capital is required for countries to benefit from FDI. However, the current study finds that such a threshold of human capital may not be required when FDI is in the form of greenfield FDI particularly when it comes with large number of project counts. A study by Feeny et al. (2014) also supports the finding that FDI contributes to economic growth. Nevertheless, similar to the other studies discussed above, these authors have not decomposed FDI into its different modes and margins.

Table 2: Margins and Modes of FDI and Economic Through Human Capital - Fixed Effects Estimator Result

	Rest of the World				Sub-Saharan African Countries			
Dependent variable: GDP_{it}^	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 6	Model 6
Greenfield intensive$_{it}$^*Human Capital	0.007**				0.010			
	(0.003)				(0.007)			
Greenfield extensive$_{it}$^*Human Capital		-0.002				0.024**		
		(0.005)				(0.012)		
M&A intensive$_{it}$^*Human Capital			0.006***				0.003	
			(0.002)				(0.006)	
M&A extensive$_{it}$^ *Human Capital$_{it}$				0.002				0.003
				(0.004)				(0.010)
Property Right$_{it}$ ^	0.257***	0.260***	0.259***	0.258***	0.172***	0.162***	0.262***	0.165***
	(0.022)	(0.022)	(0.024)	(0.022)	(0.049)	(0.048)	(0.070)	(0.049)
Sound money$_{it}$	0.015	0.019**	0.020**	0.019**	-0.025	-0.029	-0.027	-0.037**
	(0.009)	(0.009)	(0.010)	(0.009)	(0.018)	(0.017)	(0.029)	(0.018)
Freedom to globally trade$_{it}$	0.018	0.016	0.026	0.019	0.041	0.042	0.085**	0.045
	(0.014)	(0.014)	(0.017)	(0.014)	(0.030)	(0.028)	(0.041)	(0.031)
Size of government$_{it}$	-0.007	-0.006	0.002	-0.008	0.046	0.037	0.039	0.039
	(0.013)	(0.013)	(0.014)	(0.013)	(0.030)	(0.029)	(0.040)	(0.030)
Legal system$_{it}$	0.020	0.014	0.018	0.013	0.122**	0.130***	0.083	0.135***
	(0.016)	(0.015)	(0.017)	(0.015)	(0.048)	(0.045)	(0.062)	(0.047)
Openness$_{it}$	-0.448***	-0.454***	-0.454***	-0.447***	-0.629***	-0.619***	-0.645***	-0.613***
	(0.042)	(0.042)	(0.045)	(0.042)	(0.143)	(0.139)	(0.207)	(0.144)
Constat	22.577***	22.634***	22.606***	22.622***	20.974***	21.057***	20.491***	21.110***
	(0.249)	(0.247)	(0.278)	(0.250)	(0.472)	(0.444)	(0.651)	(0.458)
Year Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1150	1165	963	1146	175	190	118	184
R-sq	0.794	0.793	0.792	0.792	0.850	0.851	0.851	0.849
rmse	0.162	0.162	0.160	0.162	0.137	0.136	0.140	0.139

Note : 1. Standard errors in parentheses

2. Significant variables are denoted by ***, ** and * at 1%, 5% and 10% respectively

3. ^ denotes that the variables are in their natural logarithmic form

As discussed in related literature review section, there are a number of studies which argue that the effect of FDI on economic growth depends on the absorptive capacity of countries hosting FDI. To investigate whether different modes and margins of FDI really work via human capital in the process of economic growth, the interaction between different types of FDI and host country human capital are included into the regressions as presented in Table 2.

Table 3: Margins and Modes of FDI and Economic Through Domestic Investment Using Fixed Effect Estimator Resilt

Dependent variable: GDP^$_{it}$	Rest of the World				Sub-Saharan African Countries			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Greenfield intensive^*Domestic investment$_{it}$^	0.001***				0.001***			
	(0.000)				(0.001)			
Greenfield extensive*Domestic investment$_{it}$		0.002***				0.002**		
		(0.001)				(0.001)		
M&A intensive^*Domestic investment$_{it}$			0.001***				0.001	
			(0.000)				(0.000)	
M&A extensive^ *Domestic investment$_{it}$^				0.001**				0.001
				(0.000)				(0.001)
Human capital$_{it}$	0.191**	0.182**	0.182**	0.136*	-0.146	-0.101	-0.558	-0.095
	(0.076)	(0.076)	(0.081)	(0.077)	(0.224)	(0.216)	(0.359)	(0.227)
Propertiy right^$_{it}$	0.256***	0.243***	0.259***	0.252***	0.180***	0.174***	0.260***	0.179***
	(0.022)	(0.022)	(0.024)	(0.022)	(0.045)	(0.044)	(0.065)	(0.045)
Sound money$_{it}$	0.014	0.017*	0.018*	0.018*	-0.039**	-0.043***	-0.061*	-0.052***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.017)	(0.016)	(0.031)	(0.017)
Freedom to globally trade$_{it}$	0.016	0.015	0.024	0.018	0.064**	0.060**	0.086**	0.077**
	(0.014)	(0.014)	(0.017)	(0.014)	(0.029)	(0.028)	(0.042)	(0.030)
Size of government$_{it}$	-0.008	-0.009	0.002	-0.009	0.016	0.005	-0.008	0.008
	(0.013)	(0.013)	(0.014)	(0.013)	(0.028)	(0.027)	(0.039)	(0.029)
Legal system$_{it}$	0.024	0.022	0.025	0.016	0.088*	0.095**	0.122*	0.100**
	(0.016)	(0.016)	(0.017)	(0.016)	(0.045)	(0.043)	(0.062)	(0.045)
Openness$_{it}$	-0.425***	-0.427***	-0.434***	-0.438***	-0.666***	-0.651***	-0.706***	-0.653***
	(0.042)	(0.042)	(0.046)	(0.043)	(0.134)	(0.130)	(0.202)	(0.136)
Constant	22.011***	22.112***	22.079***	22.270***	21.556***	21.615***	21.918***	21.545***
	(0.339)	(0.335)	(0.371)	(0.342)	(0.658)	(0.619)	(1.060)	(0.650)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1150	1165	963	1146	167	182	112	176
R-sq	0.797	0.796	0.794	0.794	0.851	0.853	0.855	0.852
rmse	0.161	0.161	0.159	0.161	0.122	0.122	0.127	0.125

Note : 1. Standard errors in parentheses
2. Significant variables are denoted by ***, ** and * at 1%, 5% and 10% respectively
3. ^ denotes that the variables are in their natural logarithmic form

Interestingly, in RoW, the empirical results remain quite similar to what was reported in Table 1. As can be seen from Table 2, intensive margins of greenfield FDI and cross-border M&A interacted with human capital enter the models with positive and statistically significant coefficient. This suggests intensive margins of both greenfield FDI and cross-border M&A could affect economic growth either directly as reported in Table 1 or indirectly as reported in Table 2 via human capital in RoW. Specifically, 1% increase intensive margin greenfield FDI and cross-border M&A are associated with 0.007% and 0.006% economic growth respectively in this sub-sample of countries. This in turn implies that increase in human capital in the form of years of schooling could help countries to benefit from FDI in the process of economic growth. We say that human capital strengthens countries ability to benefit from FDI in their efforts to promote their economic growth. This empirical result aligns with the finding of Noormamode (2008).

For sub-sample of SSA, only extensive margin Greenfield FDI is found to be positively associated economic growth. Specifically, 1% increase extensive margins of greenfield FDI is associated with 0.024% change in economic growth indirectly via human capital in SSA. These findings support arguments advanced Nelson and Phelps (1966); Benhabib and Spiegel (1994).

Table 4: Margins and Modes of FDI and Economic Through Domestic Investment - GMM Estimator Result (Rpbustness Check)

Dependent variable: $GDP^{\wedge}_{(it)}$	Rest of the World				Sub-Saharan African Countries			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
$GDP_{i(t-1)}$	0.115***	0.070***	0.062***	0.085***	0.332***	0.163	0.299	0.358
	(0.010)	(0.010)	(0.004)	(0.012)	(0.117)	(0.103)	(0.197)	(0.218)
$GDP_{i(t-2)}$	-0.165***	-0.178***	-0.256***	-0.184***	-0.309**	-0.032	-0.099	-0.136**
	(0.007)	(0.007)	(0.004)	(0.005)	(0.139)	(0.080)	(0.208)	(0.065)
Greenfield intensive^*Domestic $capital_{it}$^	-0.009***				0.003			
	(0.001)				(0.008)			
Greenfield extensive^* Domestic $capital_{it}$^		-0.040***				0.032**		
		(0.003)				(0.014)		
M&A Intensive ^*Domestic $capital_{it}$^			0.004***				0.001	
			(0.001)				(0.007)	
M&A Extensive^* Domestic $capital_{it}$^				0.027***				0.019**
				(0.001)				(0.008)
Human $capital_{it}$	-3.938***	-4.151***	-4.952***	-4.040***	-8.600**	-5.592	-2.571	5.885
	(0.317)	(0.352)	(0.243)	(0.229)	(4.231)	(4.397)	(2.717)	(4.311)
Propertiy right^ $_{it}$	0.150	1.754***	1.369***	1.171***	-1.045	0.227	-0.057	-1.479**
	(0.169)	(0.185)	(0.190)	(0.086)	(1.129)	(0.987)	(0.539)	(0.713)
Sound $money_{it}$	0.036	0.502***	0.605***	0.195***	1.048	-0.106	0.040	-1.524
	(0.090)	(0.126)	(0.061)	(0.073)	(1.567)	(0.718)	(2.548)	(1.013)
Freedom to globally $trade_{it}$	-0.327***	0.082	0.494***	-0.614***	0.872	-1.222**	-0.815	-0.106
	(0.115)	(0.137)	(0.113)	(0.092)	(1.259)	(0.535)	(2.063)	(0.722)
Size of $government_{it}$	1.207***	1.098***	0.890***	1.053***	1.308	0.792	1.567	-0.802
	(0.162)	(0.075)	(0.056)	(0.121)	(2.109)	(0.772)	(0.977)	(1.439)
Legal $system_{it}$	-0.157	-0.302	-0.097	-0.020	0.872	0.267	-0.202	-0.086
	(0.113)	(0.226)	(0.135)	(0.071)	(2.111)	(0.971)	(2.133)	(0.400)
$Openness_{it}$	4.713***	7.293***	3.860***	3.713***	8.829**	3.836	-0.912	4.969
	(0.378)	(0.400)	(0.216)	(0.336)	(4.141)	(3.336)	(2.702)	(4.354)
Constant	3.896	-15.291***	-13.910***	-6.329***	-5.559	9.777	5.101	16.884*
	(2.580)	(2.511)	(2.456)	(0.988)	(12.653)	(9.365)	(11.242)	(9.397)
Number	1010	1021	846	1006	155	166	106	160

Note : 1. Standard errors in parentheses

2. Significant variables are denoted by ***, ** and * at 1%, 5% and 10% respectively

3. ^ denotes that the variables are in their natural logarithmic form

Following the discussion presented in the introduction section of the current study, it is also interesting to examine whether FDI modes and margins complements /or substitutes domestic investment in economic growth process. For this purpose, the different types of FDI are interacted with domestic investment. As reported in Table 3, regression results show that both in FDI modes and margins enter the first four models i.e., Model 1 to Model 4, with positive and statistically significant coefficient in the sub-sample of the RoW. This could imply that FDI in the form of greenfield FDI and cross-border M&A intensive and extensive margins do not displace domestic investment in economic growth process. This finding

supports a finding by De Mello (1999) which contends that the extent to which FDI affects economic growth dependents on the degree of complementarily and substitution between FDI and domestic investment. Nonetheless, as these results may suffer from endogeneity bias bases, it is important to check the robustness by another estimator which accounts for a possible endogeneity (see Table 4).

Again when only sub-sample of SSA is included, only Greenfield FDI margins enter the models with positive and statistically significant coefficient at (refer to Model 5 and 6 in Table 3). This once again reinforces results presented in the preceding tables. This shows that Greenfield FDI complements domestic investment in the process of economic growth. The complementarity between FDI modes and margins in RoW and SSA in the process of economic growth contradict the finding by Hong (2014) which argues that FDI may displace domestic investment in China.

As a robustness check, regression that account for endogeneity bias using system Generalized Method of Moments (GMM) estimator is run. Variables that affect economic growth could also affect the different types of FDI directly thereby causing endogeneity bias. As per Wooldridge (2010) the sources of endogeneity bias could be because of selection bias/or omitted variables; simultaneity (reverse causality), and/or measurement errors.

As reported in Table 4, the GMM estimator results confirm that SSA is unique in FDI-economic growth nexus. Interestingly, intensive and extensive margins of Greenfield investment still influence economic growth positively after addressing endogeneity bias. This could imply that the presence of human capital magnifies the positive influence of Greenfield FDI on economic growth in SSA reinforcing the results presented in the previous tables.

Likewise, in the sub-sample of RoW, the extensive and intensive margins of greenfield FDI and cross-border M&A enter the models with positive coefficients when interacted with human capital. This supports findings by Edwardo et al. (1998); Nelson and Phelps (1966) and Benhabib and Spiegel (1994). The may imply that the effect of FDI on economic growth is generally indirect and requires certain level of human capital to affect economic growth in the RoW.

To check the robustness of the result reported in Table 2, GMM estimator result is estimated. Accordingly, quite similar results are obtained as presented in Table 5. The results show that extensive margin of greenfield FDI still remains statistically significant in the sub-sample of SSA. In addition, extensive margin of cross-border M&A becomes statistically significant. This may show that for FDI in the form of cross-border M&A to affect economic growth, promoting domestic investment is required in SSA. Again, the results show that extensive margins of both FDI modes do complement domestic capital formation in SSA supporting the finding by Ijirshar et al. (2020) though the authors have not considered the different modes and margins of FDI.

In the sub-sample of RoW, the interaction between greenfield FDI intensive and extensive with domestic investment enter the model with negative coefficients. This may show that FDI in the form of greenfield investment could displace domestic investment in the RoW. This empirical result is in line with Hong (2014) which argues that greenfield FDI may displaces domestic capital formation in China. Nevertheless, both intensive and extensive margins of cross-border M&A enter the models with positive coefficients. This means that cross-border M&A complements domestic capital formation in the process of economic growth in RoW. This once again supports studies by De Mello (1999); Nelson and Phelps (1966) and Benhabib and Spiegel (1994).

Conclusion

The study revealed that intensive margins of greenfield FDI and cross-border M &A directly influence economic growth in RoW. In SSA, however, only extensive margin of greenfield FDI robustly and directly affects economic growth. The presence of improved human capital strengthens the effect of intensive

margins of both FDI modes on economic growth in RoW and greenfield FDI extensive margin in SSA. However, cross-border M&A extensive margin influences economic growth only indirectly via domestic investment in SSA. Whereas, intensive and extensive margins cross-border M&A could complement domestic investment in RoW, only greenfield FDI margins strongly complement domestic investment in SSA. Nevertheless, greenfield FDI might displace domestic investment in RoW. Therefore, SSA countries could benefit more from FDI in the form of larger number of greenfield FDI than inviting few greenfield investments which intensively invest in few project. Policies that enhance human capital and promote domestic investment are strategic to amplify the effect of FDI on economic growth both in the RoW and in SSA.

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Journal of Science and Sustainable Development (JSSD), 2021, 9(2), 31-42

ISSN: 2304-2702 (print); 2414-4479 (online)
DOI: 10.20372/au.jssd.9.2.2021.0331

RESEARCH PAPER

Does Advertisement Matters in Beer Brand Preference? Case Study in Ambo Town, Oromia, Ethiopia

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Abstract

Every beer brands use advertisement as a major weapon to overcome the fierce competition. The study aims to explore the effect of advertisement on consumers' beer brand preference in Ambo town Oromiya region Ethiopia. Four variables namely advertising media, source of advertisement, and characteristics of advertising messages and language of advertisement were used as independent variables, while brand preference was used as dependent variable. A total of 362 respondents were selected using judgmental sampling technique. The structured questionnaires were used to collect primary data. Data were analyzed using descriptive and inferential statistics. The finding revealed that there is positive and significant relationship between advertising media, source of advertisement, characteristics of advertising messages, type of advertising language and beer brand preference. Among advertising medias, TV is the most influential whereas outdoor advertisement has low influence in beer brand preference. Appropriate actions like upgrading attractiveness of the advertisement, making advertisement message and content persuasive, and use advertisement by understandable languages are indispensable. Further, companies need to refine their advertising strategies as a means of overcoming the intense competition that exist in the market so that they can increase sales volume and market share..

Keywords: Ambo, Advertisement, Brand preference, Media, Beer

Introduction

Advertising is a form of communication used to encourage, persuade, or manipulate an audience to continue or take some new action (Kotler, 2005). Nowadays it has a significant role on the sale of goods and services as it is all about influencing and inducing an urge to purchase the products.

According to Kotlerand Armstrong (2008) advertising is traced back to the very beginnings of recorded history. Nowadays, advertising has become a multi-billion industry employing hundreds of thousands people and affecting billions of people's lives worldwide.

So far, seeing as advertising clutter has increased tremendously and is more intense than ever, it is vital that companies differentiate themselves from competitors by creating even more powerful, entertaining and innovative advertising message that affect consumers' brand preference (Nartey,2010).

According to Agwu (2012), advertising is daily encounter because we are exposed to media. We all have and listen to TVs, radios, read various magazines, newspapers, outdoor signage, direct mails and now new innovation by websites and text messages. A good advertisement persuades the customer to the final purchase and keeps them motivated to do certain action (Kenneth and Donald, 2010). The advertising also gives customers the options

that can be considered when they go to purchase to distinguish the products among many. So that when the customer goes to purchase any thing he/she will once think about it that there is a certain product with certain features (Agwu, 2013) and (Ikpefan et al., 2014). Therefore, advertising has an important role in today's businesses.

Advertising has effect on alcohol consumption and established that advert leads to onset of drinking amongst non-drinking youth; increased levels of consumption and also revealed evidence of a dose-relationship in relation to advertising exposure (Anderson et al., 2009) and (Grube and Waiters, 2005). According to Adeolu et al., (2005) types of advertising media and age of consumers as the two factors used for the study purpose. Furthermore, Vivekananthan (2010) used three assessment factors such as information, communication, and comprehension. Features of advertisement, contents of advertising message, types of advertising media and reference group influence are the factors that affect consumption. Accordingly, first language is a choice language by audiences (Gezachew, 2012) and (Tendon, 2011).

The study by Singh et al., (2012); Adeole et al., (2005) and Ugonna, et al., (2017) revealed that advertisement has positive impact on attention and exposure of consumers'. The study also showed that media advertisements of TV and radio had a significant influence on consumers' purchase intent, while radio and billboard advertisements had significant influence on the attention, interest, desire, conviction, and action of consumers'. According to Moorthy and Madevan (2014) and Lema (2016), TV advertising is the most preferred by consumers' to have awareness about the product and chose alternative brand. Moreover, Gezachew (2012) assessed the influence of advertisement on consumers' brand preference with reference to electronics products. The study revealed that among advertising media, TV advertising is the most preferred media by consumers. Mother language is the most preferable language by audiences. To convey advertising message experts, celebrities, and common man were preferred by consumers to get reliable information of the brand. As indicated by figure 1, brand preference is influenced by types of media used for advertisement, source and language of advertisement, and message of advertisement.

Atkin, (1982) states that TV advertisement forces consumers to immerse in the matter and leads to action. There is positive and significant relationships between advertising media, source of advertisement, characteristics of advertising messages and brand preference of beer Lema, (2016) , Ugonna, *et.al*., (2017) and Wilcox and Gangadharbatla,(2006). Ayanale, et.al., (2005) find out that quality of advertisement is important in influencing brand preference. In addition to content of the advertisement, brand preference is affected by language that the consumer better understands (de Run and Khalique,2012).

The Beer industry in Ethiopia has gone through tremendous growth in the last two decades. It transformed into one of the most competitive industries in Ethiopia with millions of birr spent on advertisements alone. Every beer brands in the market use advertisement as a major weapon to overcome the fierce competition. In Ambo town, there are a number of beer products in the market such as St. George Beer, Amber Beer, Waliya Beer, Habesha Beer, Castle Beer, Zabidar, Harar Beer, Bedele Beer, Dashen Beer, Meta Beer, and Raya beer. In Ambo town the producers of different beer brands are striving to increase their market share through varying marketing strategies. With such number of beer brands it seems the competition is leveled up between the beer companies. One means to beat up the competition is through communication, where advertisement is a major tool. Hence this study tries to investigate the effect of advertisement on beer brand preference in Ambo town. The general objective of the study was to evaluate the effect of advertisement on consumers' beer brand preference. Specific objectives of the study are to; (1) Identify the type of media used in advertising beer, (2)-Assess the effect of sources of advertisement on consumers' beer brand preference, (3)-Explore the effect of advertising messages on consumers' beer brand preference and (4)-Investigate the effect of

advertisement language on consumers' beer brand preference.

Figure 1 shows the effect of independent variables (source of advertising, language of advertising, Media and Message of advertising) on dependent variable (Brand preference). Brand preference is explained by quality of beer, price and package of the beer.

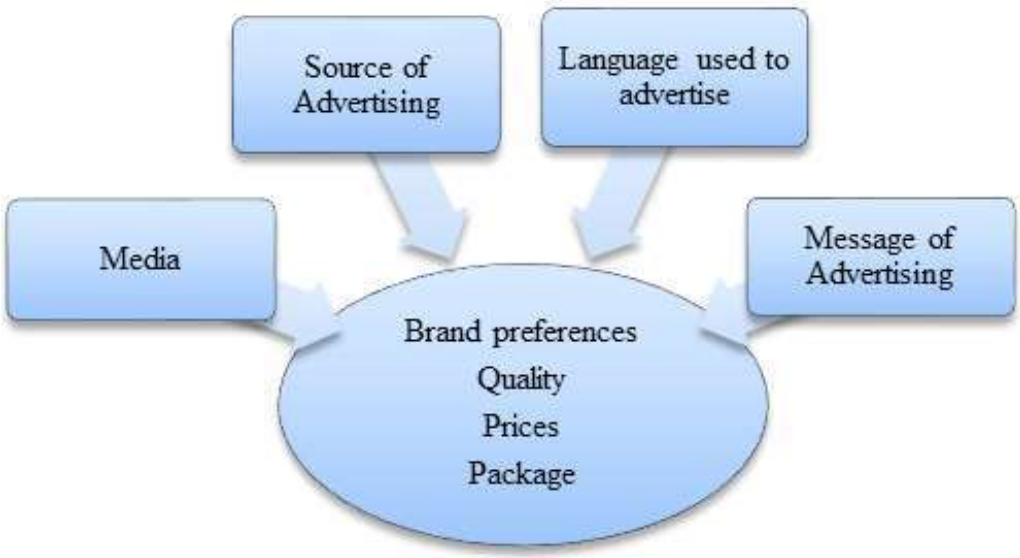

Figure1: Conceptual framework, Adopted from Gezachew (2012) and Singh et al. (2012)

Research methods

Description of the study area

The study was conducted at Ambo town West Shoa Zone, Oromia National Regional State. Relatively Ambo town is located 114 kms faraway West of Addis Ababa. The Town has a total population of about 81000 and area covering 8587.58 hectares (85875871.07m2) square meters. Besides this the town has 23 hotels and 42 restaurant and groceries which give different services to the residence.

Research approach and design

Mixed research approach was employed in determining the effect of advertisement on beer brand preference in the study area. Descriptive and explanatory research designs were employed. Descriptive was used to show the landscape of advertisement in Ambo town, whereas, Explanatory design was used to indicate the effect of advertisement on brand preference. The study targeted the Hotels, Restaurants, and Groceries found in Ambo Town.

Data types and methods of collection

Data were collected on week-end (Saturday and Sunday) afternoon since week-ends are leisure time for most of the respondents. The primary data were collected directly from the sample respondents such as the consumers of beer, sales personnel and managers of selected groceries, restaurants and hotels using structured questionnaire. The Respondents were asked if they were willing to participate in

the survey. Then they were given questionnaires to fill in based on their preference, experience and prior exposures to the brands. In this study data collector was employed and trained to collect the data from the respondents which is located in different areas of hotels, restaurants and groceries in the town. Secondary data were collected from reports, and statistics by government agencies and any other authorities. Interview was also conducted with Managers, sales man and business owners to substantiate the data by obtaining through questionnaire method.

Sampling method and sample size

The target populations for this study were consumers of beer in hotels, restaurants and groceries in Ambo Town. Sampling frame of this research were customers of Hotels, Restaurants and groceries located in Ambo Town. When the size of population is unknown the sample size was calculated by the following formula (Corbetta, 2003).

$$n = \frac{Z^2 P * Q}{e^2}$$

Where n = required sample size, Z = Degree of confidence (i.e. 1.96)2, P = Probability of positive response (0.5), Q=Probability of negative response (0.5) and E = Tolerable error (0.05)2.

Accordingly, sample size was 384.16, rounded as 384 beer users. From the stated number twenty two of the respondent were failed to respond and hence, the analysis was done with 362 samples. Purposive sampling was used to select hotels, Restaurants and groceries. From hotels, restaurants and groceries respondents who are consume beer brands and willing to fill the questionnaire were selected.

Data analysis

The data analysis was made by using both descriptive (frequency, percentage, graphs and figures) and inferential statistics. Multiple linear regression analysis was used to test the effect independent variables on the dependent variable. The following is the model specification,

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \varepsilon$$

Where Y=Brand preference x1=Type of media x2= sources of advertising x3=Messages of advertising x4= languages of advertising and ε is error term

Reliability test

Baker (1994) noted that a pilot study is used to pre-test and accordingly 10-20 % of the sample size for the actual study was a reasonable number of participants to consider in pilot study. For this study 38 respondents were selected for pretesting the questionnaire. In order to check the internal consistency of the instrument, reliability test was conducted using Cronbach-Alpha as evidenced by Oluwatayo (2012). This coefficient varies from 0 to 1, and a value of 0.6 or less generally indicates unsatisfactory level of internal consistency (Malhotra& Birks, 2007). The result of the Cronbach-Alpha on table 1 shows that the internal consistency of the questionnaire is satisfactory

Table 1: Reliability Test

Variables	Cornbach Alpha	Items
Advertising media	.886	8
Message Source factor	.911	7
Message Character factor	.839	3
Language factor	.842	3
Brand Preference	.859	6
Overall Scale reliability	.909	27

Result and discussion

Demographic characteristics of the respondents, beer preferences, major reasons for beer preference and language preference for advertisement were presented in table 2. We examined the correlation among independent and dependent variables and in addition, cause and effect relationship between independent and dependent variable were analysed.

Table 2: Demographic characteristics of the respondents

Gender			Age			Job category			Marital status			Family size		
	Fre	%		Fre	%		Fre	%		Fre.	%		Fre	%
Male	300	82.9	20-35	252	69.6	Private	175	48.3	Married	132	36.5	1-3	202	55.8
Female	62	17.1	36-50	42	11.6	Government	141	39.0	Single	199	55.0	4-6	84	23.2
	-	-	51-65	64	17.7	NGO	15	4.1	Widowed	16	4.4	7-8	39	10.8
	-	-	Above 65	4	1.1	Student	31	8.6	Divorced	15	4.1	above 8	37	10.2
Total	362	100		362	100		362	100		362	100		362	100

According to Table 2 majority of the respondents are males that imply males are high beer users compared to female counterpart. In terms of age, youngsters (20-35) are high users of beer represented by 69.6% whereas oldies are relatively low users. Private job workers are high in terms of beer usage. The table also shows those drinkers with few family members are relatively high in number. This implies those who have large family cannot use beer frequently as drinking beer has economy implication.

Table 3: Advertisement and beer preference

		Frequency	Percent
	yes	257	71.0
	no	105	29.0
	Total	362	100.0

Table 3 shows, 257(71%) of respondents replied that advertising has influenced consumers to consume beer of their preference and 105(29%) of the total respondents replied

that advertising does not influence them on beer selection. This indicates that most of the respondents are affected by advertising on beer brands selection

According to figure 2, the study shows that the most preferable beer was St. George beer 121(33.4%) of the total followed by Waliya beer 74(20.4%) which was also followed by Meta beer 71(19.6%). In the third place and fourth place Habesha and Bedele were followed by having 41(11.3%) and 21(5.8%) of the total share of brand preference. Where as Castel, Heniken, Amber, Zabider and Dashen have low preference 11(3%), 11(3%), 5(1.4%), 4(1.1%) and 3(0.8%) of the total score respectively. The study is supported by Borji and Amele, (2015) St. George beer was top preferred by beer drinkers.

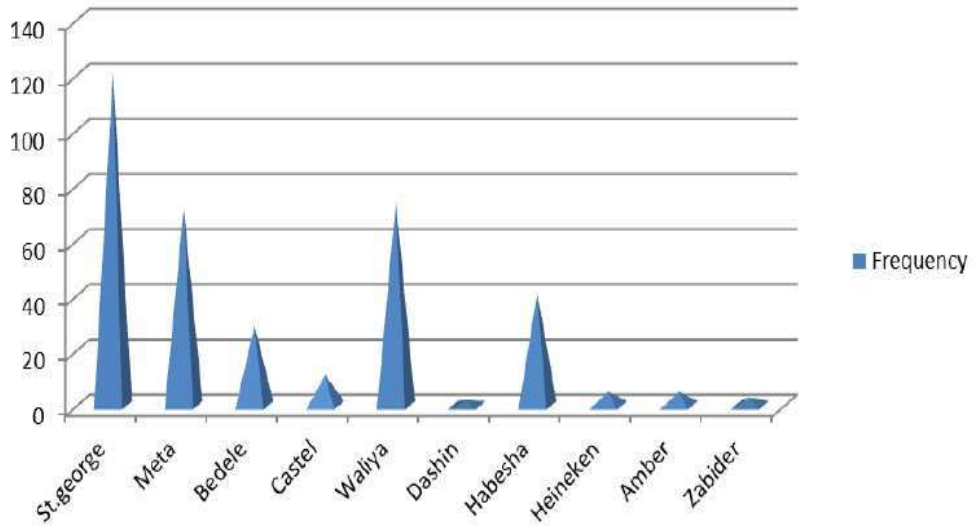

Figure 2. Beer brand preferences

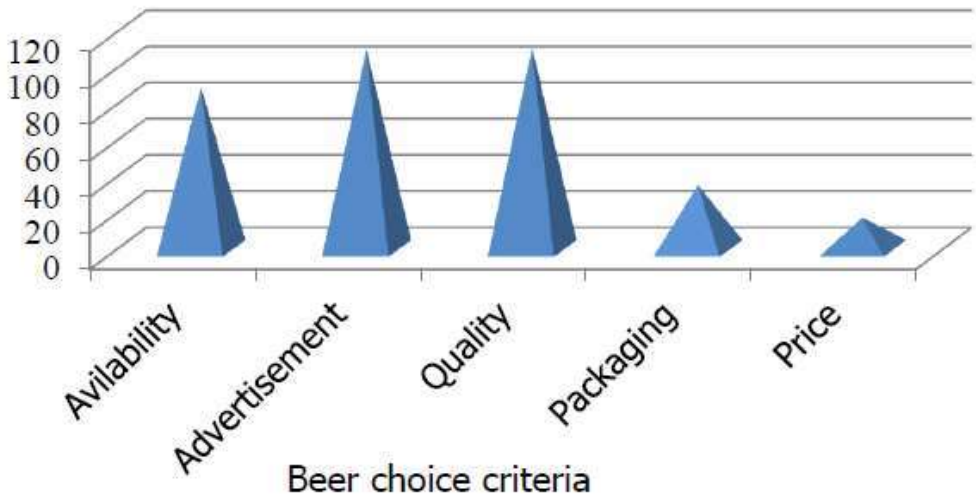

Figure 3. Reasons for beer brand choice

From figure 3, 111(30.7%) of the respondents replied that the reason for beer brand preference was based on the quality of the beer brand, 110(30.4%) of the respondents replied that the reason for their beer brand preferences depends on the advertisement of the beer brands, 89(24.6%) of the respondents replied that the reason for their beer brand preferences depend on the easily availability of the beer brands. Whereas 35(9.7%) and 17(4.7%) of the total respondents replied that their beer brand preferences relay on the Price and Packaging of the beer brands. This result indicates that most of consumers use beer depends on quality and advertisement frequency, attractiveness and persuading strength. Quality, along with advertising, is a major factor responsible for the success of the product. This finding is corroborated by Tendon (2011) and (Ayanwale et al. (2000) that manifested quality of the beverage coupled with attractive advertisement leads to preference.

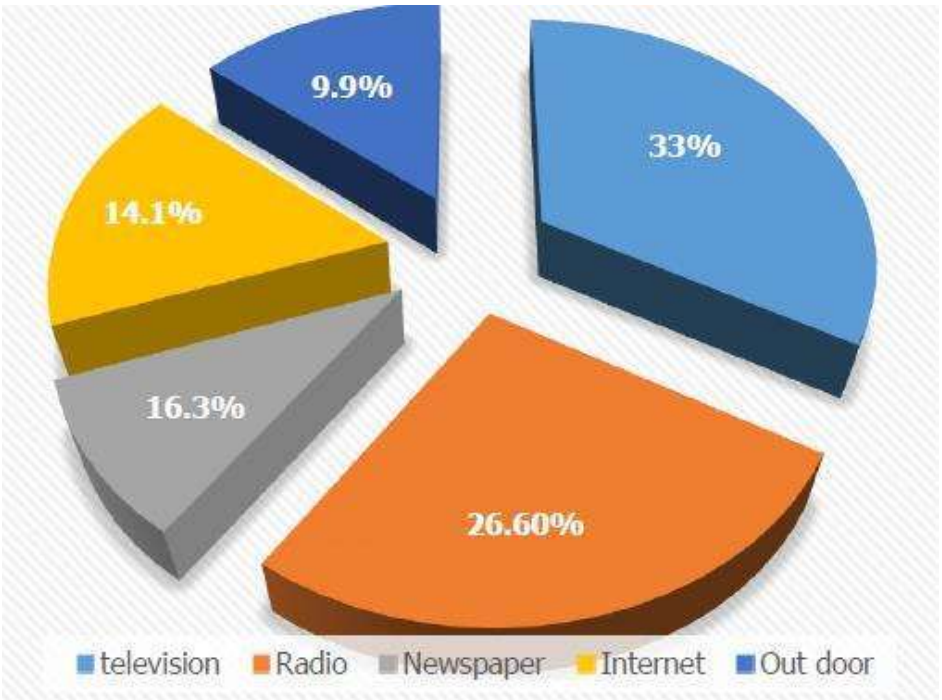

Figure 4. Types of Advertisement Media

According to figure 4, 33.10%,26.6% ,16.30%, 14.10% and 9.90% of the total respondents prefer to use TV, Radio, Internet, Newspaper and Outdoor advertisements respectively. This finding is supported by previous literatures (Ugonna etal., 2017); (Gezachew, 2012) and (Lema, 2016) that states among all advertising media, TV is most preferred media. Internet advertisement is also increasingly preferred by consumers as internet accessibility is improved and people have become owners of smart mobile phones.

Figure 5 exhibits that 287(79.3%) of the respondents replied that they preferred mother language to other languages, 40(11%) of the total respondents preferred official language and the rest35(9.7%) of the respondents replied that they would prefer international language such as English during advertisement of beer. This implies that mother tongue was the most popular language preferred by consumers of beer brand when advertisement is placed. Study by Borji and Amele, (2015) , (Gezachew, 2012) and (Tendon, 2011) revealed that advertisement by one's own language is a choice since it is easy and vivid for understanding.

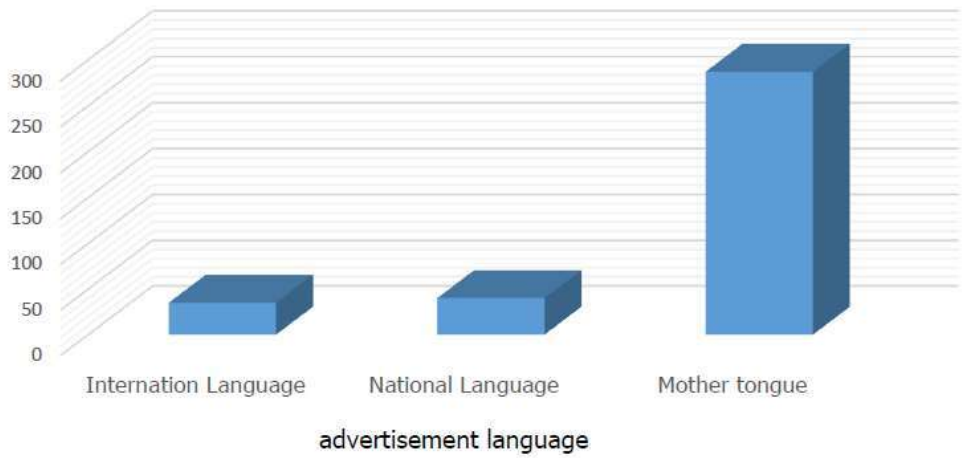

Figure 5: Language used for advertisement

Correlation between brand preference and independent variables

Correlation analysis was conducted to investigate the relationship between Independent Variables (advertising media(TMA), Source of Message (SMA), Character of Message (MCA) and Language of advertisement(TLA)) and Brand preference(BP) as Dependent variable. As shown from table 4 advertising has a strong association with beer brand preference with a value of 0.640. this collaborated with interview result. As per the person's correlation, the r value range from >0.5 shows variable is strongly correlated. According to Field (2005), 0.3-0.49 is moderate association hence; Pearson correlation coefficient value shows that Source of message, Character of message and language of advertising have a moderate association with beer brand preference with r value of .398,402 and .443 respectively.

Table 4. Correlation analysis between independent Variables (advertising media(TMA), Source of Message(SMA), Character of Message(MCA) and Language of advertisement(TLA)) and Brand preference(BP) as Dependent variable

	BP	**TMA**	**SMA**	**MCA**	**TLA**
BP	1				
TMA	.640**	1			
SMA	.398**	.414**	1		
MCA	.402**	.214**	.229**	1	
TLA	.443**	.303**	.169**	.339**	1

Linear regression assumption tests and result

The Multi-collinearity, Autocorrelation and Normality) tests were done to see the appropriateness of linear regression model.

Table 5: Multi-collinearity statistics

	Tolerance	VIF
TMA	1.31	0.763212
SMA	1.24	0.806610
TLA	1.21	0.825805
MCA	1.17	0.851195
		1.23

VIF of 5 and above is not good for regression model because it might render other significant variables redundant (Akinwande, Dikko& Samson, 2015). Therefore, table 5 shows that there is no multi-collinearity problem between variables

The study used DW to test for autocorrelation assumption of classical linear regression. Durbin--Watson (DW) is a test for first order autocorrelation i.e. it tests only for a relationship between an error and its immediately previous value. As exhibited on table 6, the null hypothesis would not be rejected if DW is near 2 therefore there is little evidence of autocorrelation (Brooks, 2008).

Normality test assumes the distribution of the residuals should be normal. This can be assessed by among other tools, using a histogram of the standardized residuals. As observed from the histogram is symmetric along the center. Therefore, this study fulfils the assumption of Normality assumption (figure 6).

Table 6: Durbin-Watson (DW) test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.728[a]	.530	.524	3.593	2.131

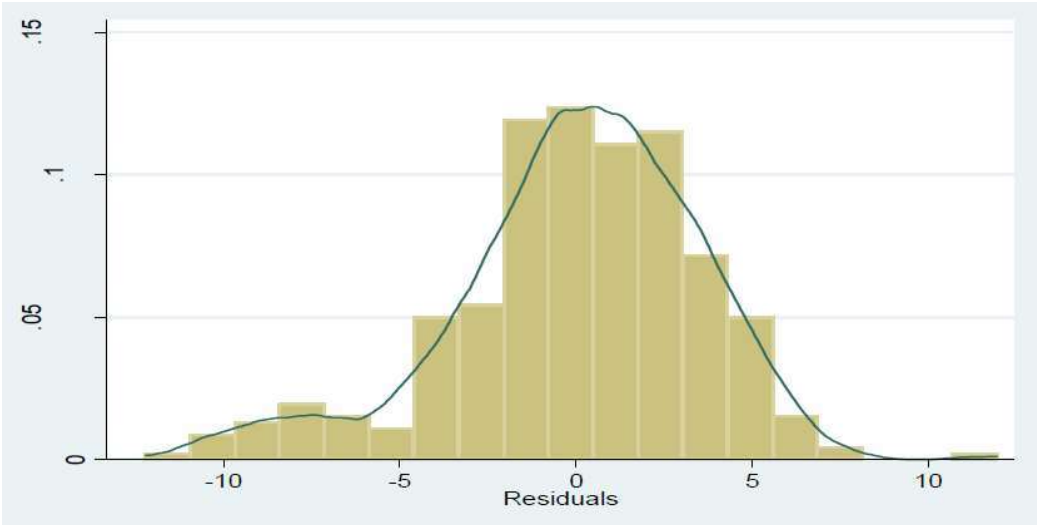

Figure 6. Normality test

Using the significance level of 0.05 and 95% confidence interval multiple linear repression was employed to analyze the effect of independent variables on beer brand preference. The independent variables were type of media, Sources of Message, Character of Message and Language of advertisement.

As exhibited on table 7 adjusted R2, 52.4% change in beer brand preference is explained by change in independent variables, whereas, the remaining is influenced by variables that are not included in the model.

Table 7: Model Summary

Model Summary				
Mode l	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.728[a]	.530	.524	3.593

[a]. Predictors

Table 8 shows the results of multiple linear regression analysis that all independent variables have positive and significant effect on brand preference. The result is supported by researches by (yang et al., 2007) and (Gezachew, 2012) stating that types of advertisement, contents of advertising message and types of advertising media are significantly and positively affects consumer beer brand preference. Taking in to consideration the results from table 6 the regressions equation for the study becomes

$$y=-7.281+.612x1+.255x2+.235x3+.384x4+\varepsilon$$

Where Y=Brand preference x1=Type of media x2= sources of advertising x3=Messages of advertising x4= languages of advertising.

Table 8: Result of regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	-7.281	1.598		-4.596	.000
	TMA	.612	.052	.486	11.479	.000
	SMA	.255	.089	.116	2.864	.004
	MCA	.235	.046	.200	5.095	.000
	LA	.384	.074	.208	5.226	.000

Conclusions

Advertising plays a major role in a marketing war during highly competitive market to attract new customers and stay in loyal customer mind, and also it has significant impact on consumers' preferences of beer brand. Consumers rely on and recall advertisements of their brands. This reliance helps them in decision making while making beer brand preference. The mission of advertiser is to reach prospective customers and influence their awareness, attitudes and prefer their brand. They spend a lot of money to keep customers interested in their products. The result shows that among the factors that determine in the choice of beer brand, advertising and quality of the beer were significant.

The finding of the study also showed that beer consumers are interested to be informed about the quality of the product and its benefit through advertising. Among advertising media, TV advertising has high degree of impact than other advertising outlets because of its audio and visual effects.

The result of correlation analysis revealed that type of media used for advertising, advertising message, source of message and type of language used for advertisement are positively and strongly correlated with beer brand preference. The result of regression analysis shows all variables have positive and significant effect on beer brand consumers preference. Advertising messages factors like message character emphasizes on good tone and action and frequency advertisement have significantly affects beer brand preference as advertisement by local language does due to its simplicity for understanding.

Recommendation

Even though, alcohol beverages TV advertisement is banned in Ethiopia from 6:00 AM in the morning to 9:00 PM in the evening it has positive impact on beer preference. Hence, beer companies have to select the most popular TV for advertisement during permissible hours. In addition, beer companies have to aware that the internet advertisement preference is increasing and internet advertisement will be their future concern. Moreover, the beer companies need to build strong brand by using creative advertisement.

Beer Companies have to develop attractive stories, documentaries, use background music advertisement with good tone and attractive actions and involve the interest of consumers in advertisement message. In addition, advertisement message needs to be attractive and persuasive that emphasizes the merits of their product that promote brand recall and brand preference. During advertisement brewery companies have to use national and mother language in order to advertise their products through the most compelling media and credible sources. In addition, international languages like English need to be used as companies are growing and looking for international markets.

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Journal of Science and Sustainable Development (JSSD), 2021, 9(2), 43-55

ISSN: 2304-2702 (print); 2414-4479 (online)
DOI: 10.20372/au.jssd.9.2.2021.0334

RESEARCH PAPER

Effects of Seed and NPS Fertilizer Rates on Yield Components and Yield of Bread Wheat (Triticum aestivum L.) in East Badawacho District, Southern Ethiopia

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Abstract

Low soil fertility and use of inappropriate seeds rates are among the major constraints limiting the productivity of bread wheat in Ethiopia in general and in the study area in particular. Thus, a field experiment was conducted to assess the effects of rates of seed and sulfur NPS fertilizer rates on growth, yield components and yield of bread wheat. Factorial combinations of three seed rates (100, 125 and 150 kg ha^{-1}), and five rates of NPS (0, 50, 100, 150, and 200 kg ha^{-1}) fertilizer, and blanket recommendation of 100 kg ha^{-1} of Di-ammonium phosphate were used for the study. The treatments were laid out in a Randomized Complete Block Design with three replications. The main effect of NPS fertilizers and seed rates significantly ($P < 0.01$) affected on yield and yield components of bread wheat. The highest spike length (7.77 cm), number of kernels per spike (61.5), and total dry biomass yield (12303 kg ha^{-1}) recorded at 200 kg NPS ha^{-1}, while the highest harvest index (0.42) was recorded at 150 kg NPS ha^{-1}. Similarly, the highest spike length (7.72 cm) and number of kernels per spike (56.85) were obtained at a seed rate of 100 kg ha^{-1}, while the highest aboveground dry biomass yield (11568 kg ha^{-1}) and harvest index (0.41) were recorded at seed rate of 150 kg ha^{-1}. The interaction of seed and fertilizer rates gave significantly the highest number of productive tillers per m2 (413) and the maximum grain yield (6250 kg ha^{-1}) at the combination of 200 kg NPS ha^{-1} with 150 kg seed rate ha^{-1}. The partial budget analysis showed the highest net return (44878.2 birr ha^{-1}) with marginal rate of return 97.7% was obtained from a combination of 200 kg NPS ha^{-1} with seed rate of 150 kg ha^{-1}. Thus, it can be concluded that seed rate of 150 kg ha^{-1} and 200 kg NPS ha^{-1} to be appropriate for bread wheat production in the study area.

Keywords: Bread wheat, Hidase, Nitrogen, Partial budget analysis, Phosphorus

Introduction

Wheat is one of the major staple and strategic food security crops in Ethiopia. It was cultivated on about 1.69 million hectares and contributed about 4.54 million tons of grain yields in the country in 2016/2017 main cropping season, which makes Ethiopia the second largest wheat producer in sub Saharan Africa next to South Africa (CSA, 2017). Bread wheat covers about 60% of the total wheat area while durum wheat covers about 40% (Alemayehu et al., 2011).

Bread wheat is also one of the most important crops in South Region and it is the third

important crop next to maize and tef in area coverage and second in productivity (2584 kg ha^{-1}) after maize (3364 kg ha^{-1}). The total wheat cultivated area and production in the South Region in 2017 were reported as 127,211.62 ha and 3287,759.19 tons, with the productivity of 2584 kg ha^{-1} (CSA, 2017).

The study area (Hadiya Zone) is also one of the major bread wheat producing Zones of Southern Nations, Nationalities and Peoples Region that covered an area of 35,795.2 ha with production of 102,894.7 tons and yield of 2.87 t ha^{-1} in 2016/17 cropping season (CSA, 2017). However, grain yield of wheat in Ethiopia (2. 67t ha^{-1}) in general and in the study zone in particular is low as compared to the attainable yield of 5 t ha^{-1} (MoA, 2012). Diseases, poor soil fertility, moisture stress, slow progress in developing wheat cultivars with durable resistance to diseases and inappropriate seed and fertilizer rate are most important constraints limiting wheat production in Ethiopia and in study area. Among the several factors responsible for low yield in Ethiopia, the use of low and unbalanced rate of fertilizers and inappropriate seed rats are important agronomic factors (Teklu and Hailemariam, 2009).

Soil erosion and nutrient mining due to sub optimal and unbalanced fertilizer uses have favored the emergence of multi-nutrient deficiency in Ethiopian soils (Agegnehu et al., 2013; Zeleke et al., 2010). Di-ammonium phosphate (DAP) and urea have been the only chemical fertilizers used for crop production with initial understanding that nitrogen and phosphorus are the major limiting nutrients of Ethiopian soils. However, in addition to N and phosphorus (P), sulfur (S), boron (B) and zinc (Zn) deficiencies are widespread in Ethiopian soils (EthioSIS, 2013).

Several researchers in Ethiopia have reported the role of N and P in wheat production in the highlands as substantial increases in yield and yield components have been obtained with the application of N and P fertilizers (Amanuel et al., 2000; Muluneh and Nebyou, 2016). Sulfur is also required for the synthesis of S containing amino acids such as cystine, cysteine and methionine. Sulfur addition showed increased N uptake when S was applied at the highest N rate, indicating a synergism between both nutrients (Fernando et al., 2009). Higher wheat grain yield with better quality requires appropriate seeding rate for different cultivars. Increase in seed rate above optimum level may only enhance production cost without any increase in grain yield (Rafique et al., 2010). Stand densities above the optimum may increase disease, plant height and lodging and do not result in higher yield. On the other hand, if less seed rate is used, yield will be less due to lesser number of plants per unit area due to less efficient utilization of growth resources (Hamid et al., 2002). Hence, achieving higher agronomic performance and better end-use quality requires optimizing and periodically reviewing management practices such as seeding rates (Asnakew et al., 1991).

The farmers in the study area use blanket recommendation of nitrogen (64 kg N ha^{-1}) and phosphorus (46 kg P2O5 ha^{-1}), i.e. 100 kg Urea and 100 kg DAP per ha^{-1} while according to the soil fertility map made over 150 districts, most of the Ethiopian soils lack about seven nutrients (N, P, K, S, Cu, Zn and B) (EthioSIS, 2013; Lelago et al., 2016). Except the blanket recommendation of nitrogen and phosphorus, the effect of other fertilizers on yield components and yield of bread wheat in the study area are unknown. According to the soil analysis map of EthioSIS the nutrient N, P and S is majour deficint nutrients in the destrict. The farmers in the study area started to use new compound fertilizer such as NPS (19% N, 38% P2O5 and 7% S). However, the rate of this fertilizer was not experimentally determined particularly for the study area for bread wheat production. The farmer in the study area use 100 kg blanket national recomandation of NPS fertilizer. Similarly, farmers in the study area use blanket recommendation of 125 kg ha^{-1} seed rate (Woreda agricultural office). However, the optimum seed rate, fertilizer type and rate at one site may not be applied at other locations because of variation in weather, soil type, soil moisture, varieties of crops, management practices, etc. which indicates the need to develop location or agro ecologic based recommendation of fertilizer and seed rates.

Therefore, this study was conducted to assess the effect of rates of seed and NPS fertilizer on growth, yield components and yield of bread wheat.

Materials and methods

Description of the Study Area

The experiment was conducted at Bantewosan Farmers' Training Centre (FTC), in East Badawacho District, Hadiya Zone during main rainy season from July to October in 2017/18. East Badawacho District is located in the Southern Nations, Nationalities, and Peoples' Region (SNNPR) between 7° 00' 05''N - 7°18' 35'N latitude and 37° 52' 0'E - 38° 11'0''E longitude. East Badawacho district is located at 277 km in the south of Addis Ababa, capital city of Ethiopia. The elevation at study site is 1850 m above sea level. It receives mean annual rainfall 1050 mm and the annual average minimum and maximum air temperatures are 11.81 °C and 27.74 °C, respectively (MBWOA, 2017).

Treatments and experimental design

The treatments consisted of factorial combination of three wheat seeding rates (100, 125 and 150 kg ha-1) and five levels of NPS (0, 50, 100, 150, 200 kg ha^{-1}) fertilizer and blanket recommended 100 kg ha^{-1} of Di-ammonium phosphate. For all the plots, 46 kg N ha^{-1} in the form of urea was applied uniformly except for the control.The details of the fertilizer treatments are shown in Table1. Bread wheat variety "Hidase (ETBW5795)" and NPS (19% N, 38% P2O5 and 7% S) fertilizer were used for the study. The variety 'Hidase' was developed and released by Kulumsa Agricultural Research Center in 2012 with on-station yield average of 4.5-7.0 t ha-1 and maturity duration of 133 days.

The experiment was laid out in a randomized complete block design (RCBD) with three replications in factorial arrangement of 3 □ 6 = 18 treatment combinations. The gross size of each plot was 2 m × 3 m (6 m2) consisting of ten rows and the distance between adjacent plots and blocks were 0.5 m and 1 m apart, respectively. The outermost one row on both sides of each plot and 25 cm of two ends was considered as border plants, and were not used for data collection to avoid border effects. Thus, the net plot was 1.6 m × 2.5 m (4 m2) consisted of eight rows of 2.5 m length. Bread wheat seeds were sown in rows of 20 cm spacing manually by drilling on 22 July 2017. The whole NPS and DAP, and ½ of the urea fertilizers were applied at sowing, while the remaining ½ of urea was applied at mid-tillering crop growth stage as top dressing.

Table 1. Nutrient composition of the fertilizer treatment used for the study

No.	Fertilizer treatments	N	P_2O_5	S
1	0 kg NPS/ha + 0 kg urea/ha	0	0	0
2	100 kg DAP/ha + 100 kg urea/ha	64	46	0
3	50 kg NPS/ha +100 kg urea/ha	55.5	19	3.5
4	100 kg NPS/ha +100 kg urea/ha	65	38	7
5	150 kg NPS/ha +100 kg urea/ha	74.5	57	10.5
6	200 kg NPS/ha +100 kg urea/ha	84	76	14

Crop data collected

Growth parameters

Plant height was measured from the soil surface to the tip of the spike excluding the awns from 10 randomly taken plants from the net plot area at physiological maturity using ruler and expressed on per plant basis in cm. Similarly, the spike length was measured from the bottom of the spike to the tip of the spike excluding the awns from 10 randomly tagged spikes from the net plot and expressed on per plant basis in cm. The productive numbers of tillers, i.e. tillers bearing spikes with grain, were determined at physiological maturity of the crop by counting from randomly selected two rows of 0.5 m length from the net plot area and converted to m2. The degree of lodging was assessed just before the time of harvest by visual observation based on the scales of 1-5 where 1(0-15o) indicates no lodging, 2(15-30o) indicate 25% lodging, 3(30-45o) indicate 50% lodging, 4(45-60o) indicate 75% lodging and 5(60-90o) indicate 100% lodging (Donald, 2004).

Yield components and yield

The number of kernels per spike was determined by counting from randomly taken 10 spikes per net plot at maturity and averaged to per spike. The thousand kernels weight (g) was determined by counting 1000 kernels sampled from each net plot after threshing using electronic seed counter from the net plot and weighing using a sensitive balance and then the weight was adjusted to 12.5% moisture content. The aboveground biomass (kg ha^{-1}) was determined by weighing the aboveground biomass per net plot area after sun drying for five days. The grain yield (kg ha^{-1}) was determined by weighed using a sensitive balance after threshing the sundried aboveground biomass and the grain yield was adjusted to 12.5% moisture content. Then, harvest index was calculated as ratio of grain yield per plot to total aboveground dry biomass yield per plot.

Data Analysis

All data collected were subjected to analysis of variance (ANOVA) procedure using GenStat 18th edition software (GenStat, 2015). Comparisons among treatment means with significant difference for measured characters were done by using Fisher's protected Least Significant Difference (LSD) test at 5% level of significance.

Economic analysis

Gross field benefit (GFB) (ETB ha^{-1}) was computed by multiplying field/farm gate price that farmers receive for the crop when they sell it as adjusted yield as GFB = AGY × field/farm gate price for the crop. Total variable cost (TVC) (ETB ha^{-1})was calculated by summing up the costs that varied, including the cost of NPS, DAP, Urea, seed and the fertilizer application costs. Cost of the variables were; NPS (11.20 birr kg^{-1}), DAP (15.76 birr kg^{-1}), urea (9.42 birr kg^{-1}) and bread wheat seed (15 birr kg^{-1}) during sowing time (July 22, 2017). Market price of bread wheat grain = 8.5 Birr kg-1and straw= 0.5 Birr kg^{-1}in Shone town at harvesting time in December 2017. The labour cost for application of NPS and DAP (6 persons ha^{-1}, each 50 ETB day^{-1}), and split application of urea two times(6 persons ha-1, each 50 ETB day^{-1}). Marginal rate of return (MRR), which refers to net income obtained by incurring a unit cost of seed rate and fertilizer, for each pair of ranked treatments was calculated using the formula

$$MRR(\%)=\frac{\text{Change in NB (NBb}-\text{NBa)}}{\text{Change in TCV (TCVb}-\text{TCVa)}} \times 100;$$

where NB_a, NB with the immediate lower, NB_b = NB with the next higher, TCV_a = the immediate lower TCV and TCV_b = the next highest TCV.

The dominance analysis procedure as described in CIMMYT (1988) was used to select potentially profitable treatments from the ranges that were tested. The discarded and selected treatments using this technique were referred to as dominated and non-dominated treatments, respectively. Then, among the non-dominated treatments, the treatment with the highest net benefit and marginal rate of return of more than 50% was considered for

the recommendation as described by CIMMYT (1988).

Results and discussion

Soil physico-chemical properties of the experimental site

The laboratory analytical results of the experimental soil indicated that the soil textural class was sandy loam with a particle size distribution of 70% sandy, 21% silt and 9% clay, slightly acidic (pH of 6.4), medium in available P (18.34 mg kg^{-1}), moderate in total N (0.23%), very low in S (6.98 mg/kg), low in organic carbon (1.5%), and high in CEC (29.54 cmol (+) kg^{-1} soil). According to Hailu (1991), soil types used for wheat production vary from well-drained fertile soils to waterlogged heavy Vertisols. Thus, the soil of experimental site is suitable for the production of wheat. The pH of the soil was 6.4, which is slightly acidic (Tekalign, 1991). FAO (2000) reported that the preferable pH ranges for most crops and productive soils are 4 to 8.

Growth Parameters

Plant height (cm)

The main effect of seed rate significantly ($P < 0.05$) influenced plant height of bread wheat while the main effect of NPS and their interaction had no significant effects (Table 2). The height of wheat plants increased as seed rate increased where the shortest plant (72.37 cm) was recorded at seed rate of 100 kg ha-1 while the tallest plant (76.10 cm) was obtained at the seed rate of 150 kg ha^{-1} (Table 2). The tallest plant height at the highest seed rate might be due to aerial intra-specific competition among wheat plants for light and space which promoted elongation of stems of wheat. In line with this result, Abiot (2017) reported that as seeding rate of bread wheat increased from the lowest (100 kg ha^{-1}) to the highest (175 kg ha^{-1}), the height of the plant correspondingly increased from 76.86 to 81cm.

Spike length (cm)

The main effect of NPS and seed rate had highly significant ($P < 0.01$) effect on the spike length of bread wheat, while the interaction effect was notsignificant. The result showed that increasing the rate of NPS increased spike length. Thus, the longest spike (7.77 cm) was obtained at the rate of 200 kg NPS ha^{-1}, while the shortest spike (6.7 cm) was recorded at unfertilized treatment (Table 2). Generally, spike length recorded over all the treated plots was significantly higher than the unfertilized plot. The increase in spike length at the highest NPS rate might have been resulted from improved root growth and increased uptake of nutrients, better growth and activate cell division. This result agrees with the findings of Muluneh and Nebyou (2016) who reported the highest spike length (7.7 cm) for wheat at the rate of 50/150 N/P2O5 kg ha^{-1}.

The result also showed that increasing the seed rates decreased spike length. Thus, the shortest spikes (7.18 cm) were obtained at the seed rates of 150 kg ha^{-1}, whereas the longest spikes (7.72) were recorded at the lowest seed rate (100 kg ha^{-1}) (Table 2). The decrease in spike length with the increase in seed rate might be due to more competition among the plants for the growth resources at higher seed rate. In agreement with this result, Ghulam et al. (2011) reported that increasing seed rate of wheat from 125 to 200 kg ha^{-1}; the spike length was decreased from 14.5 cm to 7.8 cm.

Table 2. Main effects of NPS fertilizer and seed rates on plant height and spike length of bread wheat

Treatments	PH (cm)	SL (cm)
NPS rate (kg ha^{-1})		
0	72.76	6.69^{c}
100 (DAP)	72.81	7.34^{b}
50	73.5	7.47^{ab}
100	75.67	7.61^{ab}
150	76.36	7.70^{ab}
200	74.95	7.77^{a}
Significance	NS	**
LSD (0.05)	NS	0.41
Seed rate (kg ha^{-1})		
100	72.37^{b}	7.72^{a}
125	74.55^{ab}	7.41^{b}
150	76.10^{a}	7.18^{b}
Significance	*	**
LSD (0.05)	2.78	0.29
CV (%)	5.5	5.6

¥DAP = Di-ammonium phosphate; * and ** = Significant at 5% and 1% level of probability, respectively; Means followed with the same letter (s) or no letter in the column are not significantly different at 5% level; CV (%) = Coefficient of variation; NS= non-significant; LSD $_{(0.05)}$ = Least Significant Difference at 5% level.

Number of productive tillers

The analysis of variance indicated that number of productive tillers per meter square was highly significantly ($P < 0.01$) affected by the interaction of NPS and seed rates (Table 3). The maximum number of productive tillers (413.3 m-2) was recorded from the application of the highest NPS and seed rates (200 kg NPS ha^{-1} with 150 kg seed rate ha^{-1}) and it was statistically at par with the combination of 100 and 150 kg NPS ha^{-1} with 150 kg seed rate ha^{-1} (Table 3). In contrast, the minimum number of productive tillers (110 m-2) was recorded from the combination of no fertilizer + 100 kg seed ha^{-1}. The highest number of productive tillers were recorded at the highest seed and NPS rates, this might be the increasing seed rates increased plants emerged in unit area. The current result is in line with the result of Workineh et al. (2015) who reported the highest number of effective tillers (357.3 m-2) from the combination of 92/69 N/P2O5 kg ha^{-1} fertilizer with seed rate of 177 kg ha^{-1} ha^{-1}fertilizer with seed rate of 177 kg ha^{-1} rather than the other treatment.

Lodging percent

The lodging percent was highly significantly ($P < 0.01$) affected by the main effects of NPS and seed rates as well as by the interaction of the two factors (Table 4). The highest lodging percent (38%) was recorded at the combined application of 200 kg NPS with 150 kg seed rate ha^{-1}, whereas the lowest lodging percent (21%) was recorded under application of 0 kg NPS with 100 kg seed rate ha ha^{-1}. The highest lodging percent recorded at the highest rates of NPS and seed rate might have resulted from the higher internode length, tall plant height and weak stalks due to high plant density which are easily affected by wind. In agreement with this result, Ghulam et al. (2011) reported increased lodging from 4.2 to 16.4% as the seed rate of wheat increased from 125 to 200 kg ha^{-1}. Similarly, Wakjira (2018) reported the highest lodging index (62.4%) of tef from plants that were supplied with 150 kg NPS ha^{-1}and the lowest lodging index (44.2%) from nil fertilizer application.

Table 3. Interaction effect of NPS fertilizer and seed rates on mean number of productive tillers per meter square of bread wheat

	Seed rate (kg ha^{-1})			
NPS rate (kg ha^{-1})	100	125	150	Mean
0	110.0^{j}	170.0^{i}	186.7^{i}	155.57
100 (DAP)	293.3^{def}	286.7^{defg}	293.3^{def}	291.10
50	203.3^{hi}	213.3^{hi}	320.0^{cde}	245.53
100	243.3^{gh}	273.3^{fg}	370.0^{ab}	295.53
150	276.7^{efg}	330.0^{bcd}	396.7^{a}	301.13
200	313.3^{cdef}	340.0^{bc}	413.3^{a}	355.53
Mean	239.98	268.88	330	
Significance	**			
LSD (0.05)	45.7			
CV (%)	9.8			

Table 4. Interaction effect of NPS fertilizer and seed rates on mean number of lodging % of bread wheat

	Seed rate (kg ha^{-1})			
NPS rate (kg ha^{-1})	100	125	150	Mean
0	21^{i}	23^{h}	24.17^{gh}	22.72
100 (DAP)	25.67^{def}	24.53^{fg}	25.83^{def}	25.34
50	24.8^{efg}	24.17^{gh}	25.8^{def}	24.92
100	26de	25.63^{def}	25.93^{de}	25.85
150	26.47^{d}	26.5^{d}	34.33^{c}	29.1
200	26.83^{d}	36.17^{b}	38^{a}	33.66
Mean	25.13	26.66	29.01	
Significance	**			
LSD (0.05)	0.89			
CV (%)	1.7			

Yield component and yield

Number of kernels per spike

The analysis of variance showed highly significant ($P < 0.01$) main effects of NPS fertilizer and significant ($P < 0.05$) main effect of seed rate on the number of kernels per spike (Table 5). However, the interaction effect of the main factors was not significant. The highest number of kernels per spike (61.5) was recorded at NPS fertilizer level of 200 kg ha^{-1}and it was statistically at par with 150 kg ha^{-1} (59.61) while lowest number of kernels per spike (42.12) was recorded at the control fertilizer treatment (Table 5). The highest number of kernels per spike at the highest NPS rate might be due to higher uptake of nutrients by wheat that resulted into enhanced number of grains per spike due to the synergistic effect of nitrogen, phosphorus and sulfur. In agreement with this result, Yasir et al. (2015) reported the maximum number of wheat kernels per spike (56.4) at 140 kg N ha^{-1}and 20 kg S ha^{-1}. Similarly, Workineh et al. (2015) reported the highest number of kernels per spike (38.83) of wheat from the maximum fertilizer rate (138/115 N/P2O5 kg ha^{-1}).

The highest number of kernels per spike (56.85) was recorded at seeding rate of 100 kg ha^{-1} while the lowest number of kernels per spike (51.96) was recorded at seeding rate of 150 kg ha^{-1} (Table 5). As seed rate per hectare increased, the number of kernels per spike decreased which might be due to the increase in the intra plant competition for growth resources. In line with this result, Amare and Mulatu (2017) reported that the maximum number of kernels spike-1 (41.33) was recorded from the plot that received 100 kg ha^{-1}seed rate, while the minimum number of kernels spike-1 (37.03) was from the plot that received 150 kg ha^{-1} seed rate.

Table 5. Main effects of NPS fertilizer and seed rates on number of kernels per spike, thousand kernels weight, aboveground dry biomass and harvest index of bread wheat

Treatments	NKPS	TKW (g)	AGDB (kg ha^{-1})	HI
NPS rate (kg ha^{-1})				
0	42.12^{d}	40.86	6690^{c}	0.32^{d}
100 (DAP)	52.56^{c}	43.69	9873^{b}	0.38^{bc}
50	53.08^{c}	41.88	9410^{b}	0.36^{c}
100	55.69^{bc}	42.39	9873^{b}	0.40^{ab}
150	59.61^{ab}	42.87	11192^{a}	0.42^{a}
200	61.5^{a}	45.12	12303^{a}	0.41^{ab}
Significance	**	NS	**	**
LSD (0.05)	4.56	NS	1232.4	0.03
Seed rate (kg ha^{-1})				
100	56.85^{a}	42.77	8744^{b}	0.35^{b}
125	53.47^{b}	41.74	9358^{b}	0.38^{a}
150	51.96^{b}	43.89	11568^{a}	0.41^{a}
Significance	*	NS	**	**
LSD (0.05)	3.23	NS	871.4	0.03
CV (%)	8.8	10.5	13.0	10.0

¥DAP = Di-ammonium phosphate; * and ** = Significant at 5% and 1% level of probability, respectively; Means followed with the same letter (s) or no letter in the column are not significantly different at 5% level; CV (%) = Coefficient of variation; NS= non-significant; LSD (0.05) = Least Significant Difference at 5% level.

Thousand kernels weight (g)

Analysis of variance revealed that main effects of NPS fertilizer, seed rate, as well as interaction effects had not significant effect on thousand kernels weight of bread wheat (Table 5). This might be the thousand kernels weight is a genetic characteristic of a plant which is less affected by other factors.

Though the difference was not statistically significant, the highest thousand kernels weight (45.12 g) was recorded from the highest NPS rate (200 kg ha^{-1}) while the lowest thousand kernels weight (40.86 g) was from the control (Table 5). In line with this result, Esayas (2015) reported that blended fertilizer (NPS, NPSB, NPSZnB) application had no significance effect on thousand grain seed weight of wheat.

Aboveground dry biomass

The main effects of NPS fertilizer and seed rate were highly significant ($P < 0.01$) on the aboveground dry biomass yield of bread wheat, while the interaction effect was not significant (Table 5). The highest aboveground dry biomass yield (12303 kg ha^{-1}) was recorded due to the highest (200 kg ha^{-1}) rate of NPS fertilizer and it was statistically at par with 150 kg NPS ha^{-1} whereas the lowest aboveground dry biomass yield (6690 kg ha^{-1}) was recorded from the control treatment (Table 5). The increase in aboveground dry biomass at the highest rates of NPS fertilizer rate might have resulted from improved root growth and increased uptake of nutrients which favored better aboveground growth. This result agrees with that of Dawit et al. (2015) who reported that increasing N from 0 to 184 kg ha^{-1} and P from 0 to 138 kg ha^{-1} increased the aboveground dry biomass yield of wheat by about 70.1% and 40.6%, respectively.

With regards to the effect of seed rate, the highest aboveground dry biomass yield (11568 kg ha^{-1}) was recorded at the seed rate of 150 kg ha^{-1}while the lowest aboveground dry biomass yield (8744 kg ha^{-1}) was recorded when 100 kg ha^{-1} seed rate was used (Table 5). In general, as the seeding rate increased the aboveground dry biomass yield increased which might be due to more plant populations per unit area. In conformity with this result, Abiot (2017) reported the highest biomass yield (12754.50 kg ha^{-1}) at the seeding rate of 175 kg ha^{-1}and lowest biomass yield (9696.30 kg ha^{-1}) at the seeding rate of 100 kg ha^{-1}.

Grain yield (kg ha^{-1})

The main effects of NPS fertilizer and seed rate, and their interaction had highly significantly ($P < 0.01$) effect on the grain yield of bread wheat (Table 6).

Table 6. Mean grain yield (kg ha-1) of bread wheat as influenced by the interaction of NPS fertilizer and seed rates

NPS rate (kg ha^{-1})	Seed rate (kg ha^{-1})			
	100	125	150	Mean
0	2014^{h}	2292^{h}	2188^{h}	2164.67
100(DAP)	3576^{f}	3403^{f}	4340^{cde}	3773.00
50	2465^{gh}	3194^{fg}	4688^{bc}	3449.00
100	3333^{f}	3507^{f}	5382^{b}	4074.00
150	3611^{ef}	4514^{cd}	6146^{a}	4757.00
200	3819^{def}	5278^{b}	6250^{a}	5115.67
Mean	3136.33	3698	4832.33	
Significance	**			
LSD (0.05)	737.9			
CV (%)	11.4			

¥DAP = Di-ammonium phosphate; ** = Significant at 1% level of probability;Means in columns and rows followed by the same letter(s) are not significantly different at 5% level of significance; LSD (0.05) = Least Significant Difference at 5% level; CV = Coefficient of variation.

The highest grain yield (6250 kg ha^{-1}) was obtained at combined rates of 200 kg NPS ha^{-1} with 150 kg seed rate ha^{-1} and it was statistically at par with 150 kg NPS ha^{-1}with 150 kg seed rate ha^{-1}with grain yield of 6146 kg ha^{-1}. Whereas, the lowest grain yield (2014 kg ha^{-1}) was recorded at zero level of NPS fertilizer with 100 kg seed rate ha^{-1} (Table 6)..The highest grain yield was recorded from highest NPS and seed rates this might be due to the combined effect of nutrients like N, P and S in blended fertilizer which might have boosted growth and development of crop and the highest seed rate which produced higher plant population enhanced yield components, biomass and thereby grain yield

In agreement with this result, Seyoum (2017) obtained the highest grain yield (6430kg ha-1) of bread wheat at combined rates of 150 kg NPS ha^{-1} + 46 kg N ha^{-1}. Similarly, Yasir et al. (2015) also reported the maximum grain yield of wheat (4463.5 kg ha^{-1}) at 140 kg N ha^{-1} and 20 kg S ha^{-1}. The current result noted that an increasing seed rate per hectare showed the increased grain yield per hectare at all the NPS rates which indicate that higher seed rates require higher NPS. This result agreed with the studies of Haile et al. (2013) who reported significantly the lowest grain yield (3851 kg ha^{-1}) at the lowest seeding rate (100 kg ha^{-1}) as compared to higher seeding rates (150 and 175 kg ha^{-1}).

Harvest index

The main effects of NPS fertilizer and seed rate were highly significant ($P < 0.01$) on harvesting index (HI) while the interaction effect was not significant (Table 5). The highest harvest index (0.42) was obtained from 150 kg ha^{-1}NPS fertilizer rate and it was statistically at par with 200 kg NPS ha^{-1} and 100 kg NPS ha^{-1}, whereas the lowest harvest index (0.32) was recorded with no fertilizer (Table 5). Significantly higher harvest index with the application of NPS fertilizer might be attributed to greater photo assimilate production and its ultimate partitioning in to grains as result of provision of balanced nutrition. In agreement with this result, Wakjira (2017) reported that the maximum harvest index of tef (37.53%) with NPS rate of 120 kg ha^{-1} while the lowest harvest index (33.99%) was recorded with NPS rate of 30 kg ha^{-1}. In terms of seed rate, the highest harvest index (0.41) and the lowest harvest index (0.35) were obtained due to the 150 kg and 100 kg seed rate ha^{-1}, respectively (Table 5). The increment in harvest index at higher seed rate might be attributed to proper utilization of resources and ultimate partitioning into grains compared to partitioning in to straw. In line with this result, Abiot (2017) reported the highest harvest index (38.15%) of bread wheat at seeding rate of 150 kg ha^{-1} while the lowest harvest index (31.69%) was recorded at the seeding rate of 100 kg ha^{-1} but further increase of the seed rate to 175 kg ha^{-1} decreased the harvest index to 33.27%.

Partial Budget Analysis

The partial budget analysis showed that the highest net benefit (44878.2 birr ha^{-1}) was recorded at the rate of 200 kg NPS with 150 kg seed rate ha^{-1} followed by 150 kg NPS with 150 kg seed rate ha^{-1} (44045Birr ha^{-1}), whereas the lowest net benefit (16032 Birr ha^{-1}) was recorded from zero fertilizer application at a seed rate of 100 kg ha^{-1} (Table 7).

According to CIMMYT (1988) suggestion, the minimum acceptable marginal rate of return should be more than 50%. In this study application of 200 kg ha^{-1} of NPS fertilizer with 150 kg seed rate ha^{-1} gave the maximum economic benefit (44878.2 birr ha^{-1}) with marginal rate of return of 97.7 (Table 7). In line with this result, Seyoum (2017) obtained the highest economic benefit (42272.5 Birr ha^{-1}) with the marginal rate of return 1728.3% from combined application of 100 kg NPS ha-1 and 92 kg N ha^{-1}for bread wheat.

Table 7. Summary of partial budget analysis for response of bread wheat to NPS fertilizer and seed rates in East Badawacho District, Southern Ethiopia

Treatment							MRR (%)
Seed rate (kg ha^{-1})	NPS rate (kg ha^{-1})	AGY (kg ha^{-1})	ASY (kg ha^{-1})	GFB (ETB ha^{-1})	TVC (ETB ha^{-1})	NB (ETB ha^{-1})	
100	0	1812.6	4249.8	17532	1500	16032	-
100	50	2218.5	4406.4	21060.45	3702	17358.45	60.2
100	100	2999.7	5124.6	28059.75	4262	23797.75	1150
100	100(DAP)	3218.3	5249.7	29980.4	4618	25362.4	439.5
100	150	3249.9	5812.2	30530.25	4822	25708.25	169.5
100	200	3437.1	5625	32027.85	5382	26645.85	167.4
125	0	2062.8	3937.5	19502.55	1875	17627.55^{D}	
125	50	2874.6	5094	26981.1	4077	22904.1	239.6
125	100	3156.3	5082.3	29369.7	4663	24706.7	307.6
125	100(DAP)	3062.7	5156.1	28611	4993	23618 ^{D}	
125	150	4062.6	5562.9	37313.55	5197	32116.55	4166
125	200	4750.2	6187.5	43470.45	5757	37713.45	999.4
150	0	1969.2	4018.5	18747.45	2250	16497.45^{D}	
150	50	4219.2	6593.4	39159.9	4452	34707.9	827
150	100	4843.8	5718.6	44031.6	5012	39019.6	769.9
150	100(DAP)	3906	6062.4	36232.2	5368	30864.2^{D}	
150	150	5531.4	6000.3	50017.05	5972	44045.05	2182
150	200	5625	7781.4	51703.2	6825	44878.2	97.7

Where, AGY = adjusted grain yield; ASY= adjusted straw yield; GFB = gross field benefit; TVC = total variable costs; NB = net benefit, MRR = marginal rate of return; ETB ha^{-1} = Ethiopian Birr per hectare; D = dominated treatments. Cost of bread wheat seed= Birr 15 kg-1, NPS cost = 11.20 Birr kg^{-1}, DAP cost = 15.76 Birr kg^{-1}, urea cost= 9.42 Birr kg^{-1};The labor cost for application of NPS and DAP (6 persons ha^{-1}, each 50 ETB day^{-1}) and for two time ureaaplication(6persons ha^{-1}, each 50 ETB day^{-1}), Market price of bread wheat grain = 8.5 Birr kg^{-1}and straw= 0.5 Birr kg^{-1}in Shone town at harvesting time in December 2017.

Conclusion and recommendation

Wheat is one of the most important cereal crops in the world and it is a staple food for about one third of the world's population. Low soil fertility is one of the major constraints responsible for the low productivity of wheat in Ethiopia. From the present study it is possible to conclude that both seeding and NPS fertilizer rate affect most of yield and yield related traits of bread wheat. Based on the result of this study the main effect of fertilizers revealed significantly highest spike length, number of kernels per spike, and total dry biomass yield at 200 kg NPS ha^{-1}. Similarly, the main effect of the seed rate showed the highest total dry biomass yield and harvest index at seed rate of 150 kg ha^{-1}. The interaction of the seed and fertilizer rates gave significantly the highest number of productive tillers and the maximum grain yield at combination of the highest rates of 200 kg NPS ha^{-1} with 150 kg seed rate ha^{-1}. Therefore, this study investigated and

concluded that NPS rate of 200 kg ha^{-1} with seed rate of 150 kg ha^{-1} to be appropriate for bread wheat production in study area. However, to reach at a conclusive recommendation, the experiment has to be repeated over years and locations with considerations of higher seed rate and grain quality parameters of bread wheat.

Acknowledgements

We would like to thank the East Badawacho District Agricultural and Rural Development Office for financially supporting the study. We are also grateful to Areka Agricultural Research Center for providing seeds of bread wheat and to Debrezeit Agricultural Research Center and Sodo Soil Laboratory for the soil analysis.

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ISSN: 2304-2702 (print); 2414-4479 (online)
DOI:10.20372/au.jssd.9.2.2021.0345

RESEARCH PAPER

Assessment of Financial performance of Saving and Credit Cooperative Unions: - Through PEARLS

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Abstract

The purpose of this study is to evaluate the financial performance of SACCOS in West Shoa Zone, through PEARLS. To accomplish the objective of this study, a quantitative research design was employed. The researchers used secondary data of Waltane SACCO's audited financial statements that fulfill the criteria of data available from the union's office covering the period of 2007-2011. PEARLS model of evaluating the financial performance of SACCOS is used to analyze the evaluation of financial performance. The research results show the union is strong regarding the protection of depositors' money and the effective financial structure of the union indicates mutable results. E1, E5, and E9 are slightly fluctuating above or below the standard. But, E3 and E7 are as per the standard. As the Asset's quality is concerned, except A3 all selected indicators are strong and in line with the standard. The result show that selected indicators of the Rates of return and Cost are all in line with standard except R4. Liquidity of the union show fluctuating results L1 is up to the standard, L2 is fairly in line with the standard and L3 met the standard only in 2010 and 2011. The result for sign of growth of the union indicates that all selected indicators are in line with the standard except S6. There should be an alternative source of funds for unions to have enough money to provide the loan requirement. The liquidity of the union should also be provided with very careful attention.

Keywords: Cooperative, Financial performance, PEARLS, Saving and credit cooperative

Introduction

According to the International Cooperative Alliance, (ICA, 1995), Cooperative is an "autonomous association of persons united voluntarily to meet their common economic, social, cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise." Cooperatives are based on the values of self-help, self-responsibility, democracy, equality, equity, and solidarity. In the practice of their originators, cooperative members believe in the ethical values of honesty, openness, social responsibility, and caring for others. By founding a cooperative society, people pool their resources together on a self-help basis to advance their economic, social, and cultural desires and share gains and losses equally (ILO, 1966).

As defined by (Lari, 2009), Savings and Credit Cooperatives (SACCOs) are types of cooperatives whose objective is to pool savings for the members and in turn, provide them with credit facilities. Besides that, SACCOs do have also other objectives to encourage thrift among the members and also to encourage them on how to properly manage money and proper investment practices. Based on their area of operation SACCOs are classified into two

categories and called Urban SACCOs (USAACCOs) and Rural SACCOS (RSACCOs). There are also other types of SACCOs like traders, transport, and community-based. Indeed, SACCOs, with their diverse products and services, have given a new meaning to the financial sector in Ethiopia. The most popular service of SACCOs is saving, which has been the surest way to break the vicious cycle of poverty and is fundamental to sustainable economic development (Gazette, 2016). According to the World Council of the Credit union, a credit union is a member-owned financial cooperative, democratically controlled by its members, and operated to maximize the economic benefit of its members by providing financial services at competitive and fair rates. Access to affordable, reliable, and self-sustainable financial services improves lives on many different levels. Credit unions work to expand services to people of all income levels.As per the report from (WOCCU, n.d.), in Ethiopia, there are about 20, 851 credit unions with a total member of 4,767,963. The total saving during the period is 482 million and the loan provided to their members is 124 million with a total asset of 635 million. As per the report, the penetration rate is 9.38%.

Financial institutions play a vital role in the economic resource allocation of countries. They channel funds from depositors to investors continuously. They can effectively do so if they generate the necessary income to cover the operational cost they incur in the due course. In other words, for sustainable intermediation function, these institutions need to be profitable (Aburime, 2005). Beyond the intermediation function, financial performance has critical implications for the economic growth of countries. Good financial performance rewards the shareholders for their investment. This, in turn, encourage additional investment and brings about economic growth. On the other arrow, poor financial performance can lead to institutional failure and crisis which have negative repercussions on economic growth (Flamini, 2009). The performance of firms can be affected internally or externally. While internal factors are individual characteristics that affect the financial institution's performance, macroeconomic factors are external to the institutions (Al-Tamimi, 2010). (Hansen, 2005) assert that financial performance is an essential measure to management as it is an outcome that has been achieved by an individual or a group of individuals in an organization related to its authority and responsibility, not against the law, and conforming to the moral and ethics. Such performance is the function of the ability of an organization to gain and manage the economic resources in several different ways to develop a competitive advantage. (Karbhari, 2004) contend that high financial performance reflects management effectiveness and efficiency in making use of the company's resources, and is often expressed in terms of growth of sales, turnover, employment, or stock prices. According to (Thachappilly, 2019), financial performance forms an important part of the SACCO business and it is crucial for their survival. Successful financial performance in the SACCO has a positive connotation with the capacity to manage financial issues effectively. (Reichel, 2005), states that there is a positive association between financially related activities (such as planning and financial control) and the successful financial performance of SACCOs. (Ladzani, 2011) perceives financial performance as the lifeblood of small-scale organizations, since without them, no growth decisions can be made. In a country where the financial sector is dominated by SACCOs, any failure in the sub-sector has an immense implication on the economic growth of the country. This is because any bankruptcy that could happen in the subsector has a contagion effect that can lead to crises and bring overall financial crisis and economic tribulations (Ladzani, 2011).

The purpose of this study is to evaluate the financial performance of Waltane SACCOS Union that meet the criteria of data availability and to analyze using PEARLS model with a secondary data covering from 2007-2011.SACCOs play an indispensable role in economic development as part of the financial system. According to the report from FCA (2017), there are about 19,805 Primary SACCOS in Ethiopia. This number covers about 25% of the total other primary cooperatives in the country. Besides, there are

about 115 SACCOS Unions throughout the country (FCA, 2017).

RUSACCOs in Tigray region are weak in terms of their financial structure and profit generating capacity. They invested much of their resources in a less productive or profitable assets and finance their assets using much capital from members' share capital which cannot be used for loan disbursement, instead of saving deposits. (Ghebremichael, 2014)

SACCOs are now a vibrant instrument comprised by the Government towards increasing financial inclusion especially now that financial transactions are inclining towards a cashless economy. In light of this, various scholars such as (Hakelius, 2006), (Hannah Kiaritha, 2013), (Unal VU, 2009), (Bhuyan, 2007), (Nyoro JK, 2007), (SA, 2009), (Pollet, 2009), (Ayalew, 2013), (Fitsum, 2016) have conducted studies on financial performance of various sectors movement and using various variables namely; competition from commercial banks; members' royalty and active participation; financial, organizational, educational factors, membership, and legislative support; members satisfaction and members participation; economic factors, management committee, and staff members; voice and effective representation of SACCO's respectively as key issues contributing to the financial performance and survival of SACCOs. To my acquaintance there is no a research conducted on evaluating the financial performance of SACCOs through PEARLS in West Shoa Zone of Oromia Regional State, Ethiopia. Therefore, this study tries to fill the gap in the existing literatures and above all the financial performance of Waltane SACCO Union by using the key factors that affect the performance through PEARLS. The main purpose of this study is to assess the financial performance of Waltane SACCOs Union trough PEARLS.This study was designed to address specifically the Protection, efficiency, asset quality, rate of return, liquidity and sign of growth of Waltane Ambo SACCOS Union.

Materials and Methods

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Type of Research Design

To understand the performance of the SACCO union better in this study, the researchers employed a quantitative research approach. To accomplish this task, the researchers were used the descriptive technique where the study begins with the quantitative approach initially to collect and analyze secondary data of the sampled SACCO union to generalize results. Therefore, in this study, the quantitative strategy was implemented with much higher concern.

Type and Source of data

To address the research objectives a PEARLS model was considered that it's the most appropriate. Many different financial ratios and "rule of thumb" have been promoted for financial institutions worldwide, but few have been consolidated into an evaluation program that is capable of measuring both the individual components and the system as a whole. Since 1990, the World Council of Credit Unions, Inc. has been using a set of financial ratios known as "PEARLS" (Richardson, 2002). To achieve the objective, the researchers used secondary data. The secondary data for this study was obtained from the Audited financial statement of the union. for five years from 2007-2011.

Selection of the study area

The study area was West Shoa Zone and is selected based on the nearness to our work area because the research is conducted by self-sponsor. Waltane SACCO Union is selected because it's the only union in the area.

Sample Selection

The union is the only in the study area, therefore, the union was selected without any statistical sampling method and it was selected purposively. Out of a total of 44 ratios sated as a standard to measure financial performance by WOCCU, we have selected 24 based on the significance and compatibility to our country.

Method of Data Analysis

Method of data analysis employs quantitative approach by making use of quantitative analysis. The secondary data are collected and summarized in an excel database containing the variables identified. After that ratios were calculated based on the summarized excel data and analyzed by using the PEARLS model (Sathyamoorthi, 2016).

Result and Discussion

In this chapter, the researchers present the main result and discussions using the quantitative approach. This chapter presents the assessment of the financial performance of WAltane SACCOs union in West Shoa Zone.

Table 1: - Protection Indicators

Indicators of Protection	**Proposed Standard**	**2007**	**2008**	**2009**	**2010**	**2011**
P_1: - Allowance for loan losses/Allowances Required for Loans Delinquent >12 Months	100%	100%	100%	100%	100%	100%
P_3: - Total charge-off of delinquent Loans>12 Months	100%	100%	100%	100%	100%	100%
P_6: - Solvency	>110%	287%	277%	350%	362%	328%

The indicators in this section measure the adequacy of the provisions for loan losses. Allowance for loan losses/Allowances required for loans delinquent >12 months (P1) is used to measure the union's adequacy of the allowances for loan losses when compared to allowance required covering all loans delinquent over 12 months. The result of allowance for loan losses to allowance required for loans delinquent for a period of greater than 12 months shows that Waltane SACCO union has complied with the WOCCU model in provision for allowance required for loans delinquent standard. The WOCCU model gorged that any savings and credit union should provide 100% allowances for loan past due for more than 12 months. P1 is 100% in all the study periods which means Waltane SACCO union has adequate provision to cover the delinquent losses.

The second protection measurement that was used for this particular study is the Total charge-off of delinquent Loans>12 Months (P3). This ratio measures the total charge-off of all delinquent loans >12 months. P3 shows that the total charge-off of delinquent loans over 12 months of the union is in line with the standard that is given by WOCCU to cover the adequacy of the allowances for loan losses. According to the WOCCU model, the total charge-off of delinquent loans over 12 months should be 100%, there is no delinquency in the union during the study period.

The third protection indicator used in this study is solvency (P3). As per the model, the solvency ratio should be greater than 110%. Waltane's solvency during the study period is greater than the standard. The result shows that there are ups and downs on the values from year to year, in 2007 the value is 287%, in 2008 it's decreased to 277%, then in 2009 it's increased to 350% then in, 2010 it's increased to 362% and in 2011 decreased to 328%. Even though it's fluctuating from period to period

it's by far greater than the standard stuffed by WOCCU. From this result, we can say that the union is solvent enough to pay the members share and saving deposits upon liquidation.

Effective Financial Structure

The financial structure of the credit union is the single most important factor in determining growth potential, earning capacity, and overall financial strength. The following idyllic targets were purposively selected to ponder the performance of waltane SACCO union.

Table 2: -Indicators of Effective Financial Structure

Indicators of Effective Financial Structure	Proposed Standard	2007	2008	2009	2010	2011
E1: - Net Loans/Total Assets	Between 70-80	69%	116%	98%	82%	79%
E3: - Financial Investment/Total Assets	Max. 10%	2%	2%	1%	3%	4%
E5: - Saving Deposits/Total Assets	70-80%	40%	45%	38%	38%	42%
E7: - Member Share Capital/Total Assets	Max. 20%	11%	8%	6%	5%	4%
E9: - Net Institutional Capital/Total Assets	Min. 10%	13%	11%	8%	8%	8%

The first indicator for effective financial structure used for this study is Net Loans/Total Assets (E1). The result net loans to total assets (E1) of Waltane SACCO union in the year of 2011 (table 2), indicates the union was in line with the proposed standard which reflects the union was funding a loan out of its total assets that is within the range. WOCCU's standard states that, out of total assets of the union 70-80% should be members deposit saving but, this criterion was achieved only this year. In the year 2007, it's a little bit below the standard and it implies that members deposit savings is not enough to provide loans to members so, the union should find another source of funds like borrowing from externals to satisfy member's loan claim. However, in the years 2008,2009 and 2010 net loan to total assets ratio are above the standard. Especially in 2008 it's by far discerned from the gap stated by WOCCU. This is an implication that shows, the total assets of the union are by far less than the net loan during the period and therefore, the union cannot provide loans to its members from saving deposits. If there is not enough amount of assets to provide loans, then the union should go to take borrowing from other funding sources like banks and give loans to its members by having additional interest to members. While we consider the overall performance of the union as net loans to total assets, we can say it approaching but not in the given range and the difference is very large for the year 2008.

As presented in the table above, financing investments to total assets (E3) of the union is within the standard. As per the result, this ratio is in line with WOCCU's standard with increasing rates and this implies that the investment can be increased but it cannot be greater than 10%. So, during the study period, the minimum financing investment to total assets ratio is 1% during the year 2009 and the maximum is in 2011 which is 4%. As this ratio is increased the ability of the union to pay its loan is also increased and it can secure to its members that they will have a continues loan delivery guarantee but, it should not be greater than the stated amount because if its greater than the standard the union's total asset is going to be tied up too long-term investment and it creates a shortage of cash in the union and the union will not be capable of delivering enough amount of loan to its members.

The percentage of total assets financed by member savings deposits were still below the 70 -80% targets (E5) in the study periods. There are unstable saving deposits to total asset ratios (unhealthy percentage) suggests that members are saving to borrow money; the union no longer able to offer competitive rates on members saving; the effects of implementing new savings products were yet to be felt which implies also that Waltane saving and credit union has no effective marketing programs and the union was doing on the wrong way on achieving financial independence during the periods of study. For this purpose, if we consider it year by year, in 2007 only 40% of the total assets are members deposit and in the next year, it was increased by 5%. In 2008 though there is an improvement it's far from the standard of WOCCU. In 2009 and 2010 there are a similar amount of saving deposits to total assets which is 38% and its minimum ratio that is achieved by the union during the study period. The maximum of this ratio is scored in 2011, which is 42% and this is also by far from the standard. As saving a deposit to total assets ratio is decreased the union's capability to provide loans to its members is also decreased.

The result for member share capital to total asset (E7) of the union is within the standard but it's far from it, which means the WOCCU standard says the maximum of this ratio should be 20%. As it's indicated in table 3, the maximum of this ratio is obtained during 2007 (11%). This reveals that out of the total assets of the union 11% is member's saving and therefore, the majority of the union's asset is from liability might be from members saving or outside borrowing. The minimum amount is 4% in 2011. As this ratio is decreased implies that the union went to search for other sources of finance may be a bank, because in E5 the result reviled that saving a deposit to total assets ratio is below standard, for this reason, the majority of the assets of the union is borrowed assets.

Another ratio that is used to measure the effective financial structure of the union and selected for this study is the net institutional capital to total assets (E9) ratio. The maximum amount obtained for this ratio is 13%, but the form is decreasing and this implies that the union is depending on external loans rather than members share capital and saving deposits. If we look at the WOCCU standard it says it should be a minimum of 10%, but the union achieved this only in 2007 and 2008; in the years 2009, 2010, and 2011 the value of this ratio is 8% and it's below the standard.

Asset Quality

The indicators of asset quality measure the percentage of non-earning assets that negatively impact profitability and solvency. They are loan delinquency, non-earning assets, and the financing of non-earning assets.

Table 3: - Indicators of Asset Quality

Indicators of Asset Quality	**Propose Standard**	**2007**	**2008**	**2009**	**2010**	**2011**
A1: - Total loan delinquency/Total Loan Portfolio	<=5%	0	0	0	0	0
A2: - Non-Earning Assets/Total Assets	<=5%	1%	1%	5%	0%	0%
A3: - Net Institutional Capital/Non-Earning Assets	>=200%	294%	640%	44%	250%	208%

As it's indicated in the table above total loan delinquent to the total loan portfolio is fully matched with WOCCU's standard. The standard says that this ratio should be less than or equal to 5%, but throughout the study period the result is shown zero. This is implying that there is no loan delinquent within the study period and therefore almost all the assets of the organization are invested in earning activities. This reveals that the quality of the assets of the Waltane SACCO union is going in line with the standard prescribed by the WOCCU model and Waltane SACCO union has efficient credit management to control delinquency and also the union has effective portfolio management which helps to maintain the financial health. The reason behind the delinquent ratio becomes far below the WOCCU benchmark is from the obtained data of Waltane SACCO union there has not been any delinquency revealed so far in the study periods. However, this does not mean that they are free from delinquency.

Another indicator of asset quality measurement is non-earning assets to total assets ratio (A2). This ratio is used to measure the percentage of the total assets not producing income. Such assets should not exceed 5 percent of the total assets of a financial cooperative. In the case of WAltane SACCO union (Table 3) percent of such assets are in line with WOCCU standard which is 5 percent of its total assets during the study period. The proportion of nonearning assets has below the standard in each year during the study period particularly in the years 2010 and 2011 it's zero and this implies that the union's assets are majorly earning assets. The maximum amount of this ratio is obtained in 2009 and its 5% of the total. The minimum amount that is found from the study for this study purpose is 1% in 2007 and 2008. In general, non-earning assets should be financed with zero cost funds. We can also measure assets quality by using net institutional capital to non-earning assets (A3). This ratio is used to measure the percentage of non-earning assets that are financed with institutional capital, transitory capital, and liabilities without interest.

As it is indicated on the table above the highest amount of net institutional capital to non-earning assets was obtained in the year 2008 which is 640% and it's very far from the standard (>= 200%). This implies that during this year the union has invested almost all of its assets and they become earning assets. The result of A2 above indicated that the non-earning assets to total assets ratio were 1%, therefore, the union was good this period on in investing its assets. The minimum amount of this ratio was obtained in 2009 and it's 44%. This is too far from WOCCU's standard and this implies that during this period the investment of non-earning assets by the union was poor compared to the rest of the period. The result from A2 above also show a similar result to this, it says out of total assets of the union, non-earning assets were 5% which is the maximum limit stated by the union. In the rest of the years 2008, 2010, and 2011 we can say that the ratio of net institutional capital to non-earning assets is fair and within the given range. In general, while reducing the percentage of non-earning assets is important, the financing of those assets is just as important.

Rates of Return and Cost

The first ratio that has been selected to measure rates of return and cost for this study is liquid investment income to average liquid investment (R2). The purpose of this ratio is to measure the yield on short-term investments.

As per the result from the financial statement of the union and presented in the table above R2 is in a good position while compared to the standard by WOCCU. The highest ratio for this is maintained by the union in the year 2010 and 2011 which is 11%, this implies that out of average liquid investments that the union has about 11% is converted to income from liquid investments.

Table 4: - Indicators of Rates of Return and Cost

Indicators of Rates of Return and Cost	Proposed Standard	2007	2008	2009	2010	2011
R2: - Liquid Investment Income/ Average Liquid Investment	Highest rate	6%	10%	9%	11%	11%
R4: - Non-Financial Income/ Average Non-Financial Investment	Min. 10%	5%	11%	290%	11%	12%
R6: - Borrowed Fund/Average Borrowed Fund	>inflation	74%	88%	96%	86%	79%
R8: - Gross Margin/ Average Total Assets	Sufficient Income	7%	9%	8%	8%	8%
R9: - Operating Expenses/ Average Total Assets	<10%	4%	6%	6%	6%	6%
R12: - Net Income/ Average Total Assets	<10%	3%	3%	2%	2%	2%

The standard normally allows us to have the highest rate of this ratio; as per the standard, this ratio is also an increasing pattern except that in 2009 its 9%. The minimum of this value results in 2007 amounted to 6%. So, as per the result, the overall yield that the union has during the study period is best.

Another way through which we can measure rates of return and cost is by using the ratio of liquid investment income to average liquid investment (R4). As per WOCCU's standard except 2007, all the years in the study period are out of it, in 2007 the calculated value is 5% while the standard says a Minimum of 10% this implies that the union has earned acceptable income from its liquid investment. But in the next years, the result is out of the box and even in 2009, it's very extreme and this might be because of the reason that during this year the union has earned more income from liquid investments than ever.

Borrowed fund to average borrowed fund (R6), can also be used in determining rates of return and cost. The main purpose of this ratio is to measure the yield or cost of all borrowed funds. The maximum amount that was obtained for the borrowed fund is 96% in 2009 (table 4), this implies that during 2009 the union has taken more loans while compared to the rest of the years within the study period. The minimum of this ratio was obtained in the year 2007 and its amount is 74%, this implies that relatively the union has taken fewer loans in this year compared to others. The result indicates that it's above the inflation rate for all the years (15.37%) and this is an implication for that the union's most assets are composed of borrowings rather than share capital and saving deposits by the members. Unlike commercial banks that try to minimize financial costs, credit unions should try to pay as a high rate as possible without jeopardizing the stability of the institution.

Gross margin to average total assets (R8) is used to measure the gross income margin generated, expressed as a yield on all assets, before subtracting operating expenses, provision for loan losses, and other extraordinary items. As it's shown in the table above, the minimum amount was registered in 2007 which is 7% and the maximum is registered in 2008 which is 9%. While the result obtained is compared to WOCCU's standard throughout the study period the result is acceptable and this implies the union's operation was best in this regard. The average total assets of the union can generate enough amount of gross margin before subtracting operating expenses and other related costs. Regarding generating gross margin from the

average total assets of the union, we can say that the union was doing best.

Operating Expenses to average total assets ratio (R9) is an indicator used to measure rates of return and cost. This ratio is used to measure the cost associated with the management of all credit union assets. This cost is measured as a percentage of total assets and indicates the degree of operational efficiency or inefficiency. Then, as it's presented in table 3, starting from 2008 until 2011the union scored the same amount of operating expenses to average total assets ratio which is 6% and when we compare it to the standard (<10%) it's matched to the standard. This implies that within these four years the union's operating was increased at an equal amount while the asset of the union is remaining the same or decreasing. Whereas in 2007, R9 is only 4% it's far from the standard and it indicates that during this year average total asset of the union is much greater than the union's operating expenses. The overall result in this ratio indicates that until this day the union's ability to pay its operating expenses using its assets is best, so, we can say that the union is efficient.

Another way to measure rates of return and cost is net income to average total assets ratio (R12). This ratio is used to measure the adequacy of earnings and also, the capacity to build institutional capital. The result for this ratio is 3% in 2007 and 2008 and 2% in 2009, 2010, and 2011 (table 3), this is not the same with the standard satiated by WOCCU which is a minimum of 10%. This can imply that the union wasn't generating enough amount of net income using its average total assets. Even though there is a net income in the union during the study periods it's not up to expected or intended to generate income. Therefore, for this particular result shows that the union was inefficient.

Liquidity

The result Liquid Investments (+) Liquid Assets (-) Short-term Payables/Savings Deposits (L1) this ratio is used to measure the adequacy of the liquid cash reserves to satisfy deposit withdrawal requests, after paying all immediate obligations less than 30 days. The result shows that L1 is by far from the standard proposed by WOCCU. The standard states the minimum number of savings deposits should be 15%, but the result is not matching in all the study periods. The maximum of this ratio is recorded during the year 2009 which is amounted to 380% and this implies that during this year the savings deposits of the Waltane union are highly less than the amount of liquid investment plus liquid assets minus short-term payables divided by savings deposit. The minimum amount is recorded in 2008 which is 342%, we have the same reason as above for this one also except that the number here blows the previous one. In the years 2007, 2010, and 2011 the result lied between what is previously stated and this indicates there is a fluctuation in the L1 ratio in the union during the study period. Because of this most of the withdrawals and loan requirements are going to be satisfied by taking external loans, then this increased the liability of the union and also expenses of the union, then the profitability of the union is questionable. As per the result from this ratio we can say that the union was not liquid as well as not profitable as expected.

Another indicator of Liquidity is Liquid Reserves/Savings Deposits (L2). The liquid reserve requirement (L2) is out of the WOCCUs proposed standard.

The WOCCU's model proposed to maintain saving deposits as liquid assets equal to 10% after paying all short-term obligations less than or equal to 30 days and Waltane SACCO union did not maintain such liquidity reserve in any of the study periods (Table 1). This suggests Waltane SACCO union couldn't meet cash needed for withdrawals, however, this reflects also the union able to avoid the opportunity cost lost on idle liquid assets because funds in checking accounts and simple savings accounts earn negligible returns, in comparison with other investment alternatives. The result states that it's very approaching to the standard during the years 2007, 2010, and 2011 which is calculated to 13%, 11%, and 9% respectively and this indicates that during these periods the union was good on maintaining liquid reserves from savings deposits.

Table 1: - Indicators of Liquidity

Indicators of Liquidity	**Proposed standard**	**2007**	**2008**	**2009**	**2010**	**2011**
L1: - Liquid Investment + Liquid Assets - Short-term Payables/ Savings Deposits	Min. 15%	369%	342%	380%	377%	349%
L2: - Liquid Reserves/Savings Deposits	10%	13%	36%	251%	11%	9%
L3: - Non-earning Liquid Assets/Total Assets	<1%	1%	1%	5%	0%	0%

Whereas during the years 2008 and 2009 the result shows far from the standard and this implies that during this period the union was poor on maintaining its liquid reserves from savings deposits, especially in 2009 the gap is very huge that shows the liquidity reserve of the union is in danger.

Non-earning Liquid Assets to Total Assets (L3) is also one of the indicators of the liquidity of the unions. This ratio is used to measure the percentage of total assets that are invested in non-earning liquid accounts. As presented-on in table 5 above, in 2010 and 2011 the union invested less than the required amount in non-earning liquid assets and the amount is zero and this implies that during these periods the union was best performed. In the year 2009 L3 is 5% of total assets and this implies that during this period the union's performance was poor or underperformed. In 2007 and 2008 the result is 1%, even though the requirement says less than 1% the results during these periods reveal that is equal to 1% and this implies that during this period the performance of the union was average. So, the overall liquidity of the union is fair but the union needs to do more on savings deposits.

Sign of Growth

The gages of this section measure the percentage of growth in each of the most significant accounts on the financial statement, as well as growth in membership. In inflationary economies, real growth (After subtracting inflation), is a key to the long-run viability of the credit union.

Table 6: - Indicators of Sign of Growth

Indicators of Sign of Growth	**Proposed Standard**	**2007**	**2008**	**2009**	**2010**	**2011**
S1: - Current Loan Portfolio Balance/Loan Portfolio as of Last Year-end	**>S11**	100%	57%	269%	103%	137%
S5: - Total Current Savings Deposits/Total Savings Deposits as of Last Year-end	**>S11**	28%	80%	36%	47%	60%
S6: - Total Current Borrowed Funds/Total Borrowed Funds as of the Last Year-end	**<S11**	41%	57%	84%	50%	32%
S7: - Total Current Members Shares/Total Members Shares as of Last Year-end	**>S11**	72%	17%	15%	27%	30%
S10: - Current Number of Members/Number of Members as of Last Year-end	**>12%**	58%	16%	15%	13%	15%
S11: - Total Current Assets/Current Assets as of Last Year-end	**>15.37%**	31%	62%	59%	48%	45%

In table 6 above, selected indicators of the union as a sign of growth of Waltane SACCO union and are discussed one by one as follows:

The first ratio selected to indicate growth in the union is the current loan portfolio balance/loan portfolio as of last year-end (S1). This ratio is used to measure year to date growth of liquid investments. The result indicates that during the study period all the results of the period are in line with WOCCU's standard. The standard states that the loan portfolio should be between 70-80%of the total assets and as much as possible the union has to increase its loan provision to members. In 2007 the loan portfolio of the union was increased by 100% while compared to 2006 and it was increased by 57% in the next year (2008). In the year of 2009, the loan portfolio of the union was increased with the highest amount from the study period, and its 269%, and this indicates that during this period the requirement of the members for the loan was highly satisfied. In 2010 and 2011 the ratio found is 103% and 137% and this implies that during this period the union's growth regarding loan portfolio was increased but it less than in 2009. The overall result from this result indicates that the union is in a good position regarding the loan portfolio.

Another way through which we can measure the growth of credit unions is saving deposits and this ratio is stated as total current saving deposits to total deposits as of last year-end (S5). The main purpose of this ratio is to measure the year-to-date growth of savings. In 2007 the result is 28% this implies that the saving deposits of the union are increased while compared to 2006, but while compared to the standard it's below the standard which is S11, for this study S11 is 31%. In 2008 and 2011 saving deposits of the union was increased by 80% and 60% respectively and their result is also above the standard, whereas in 2009 and 2010 there is an increment is saving deposits of the union, but they are below the standard (table 6).

We can also measure the growth of the union by borrowed funds. Total current borrowed funds to total borrowed funds as of last year-end (S6). This ratio is used to measure the year-to-date growth of borrowed funds. The result indicates that the borrowed fund is also increased during the study period but there is up and down. The maximum amount obtained for this ratio is 84% during 2009 and it's above the standard and the minimum was obtained in 2011 which is 32%, while compared to the standard it's below the standard of WOCCU. These results imply that even though there is an increment on borrowed funds of the Waltane SACCO union but it's not up to the standard.

The total current member share to total member share as of last year-end (S7) is also one way through which we are going to measure the growth of the union. This ratio is used to measure the year-to-date growth of members share. The highest of this ratio was recorded during 2007 which is 72% and it's greater than the standard. The minimum increment in members' share was found in 2009 which is 15% and it's below the sated standard by WOCCU. In the rest of the years, the results found were 17%, 27%, and 30% for the years 2008, 2010, and 2011 respectively (Table 6).

The current number of members to the number of members as of last year-end (S10) is also one of the indicators of the sign of the growth of credit unions. This ratio is used to measure year to date growth in membership of the credit union. Throughout the study period, the result found is greater than the standard (table 6). But during 2007 the result found is 58% which is very exaggerated and this implies the number of members in 2006 is by far less than that of the current year. Since it indicates the growth of the union it's acceptable. WOCCU standard says that S10 should be greater than 12% and the minimum is scored in 2010, even though its minimum is increased while compared to the standard said. In the rest of the years, the result found is fair and comparable to the standard and this is an implication for that the union's growth in membership is best.

Total current assets to current assets as of last year-end ratio (S11), is one way through which we can measure the growth of the credit unions. The result originate is in line with the standard but it's not a healthy growth. During 2008 the result is 62% and this might indicate that most

of the current assets are from borrowing; especially cash. The standard says that current S11 should be greater than inflation (15.37%), from the website of NBE. The minimum is 31% which is scored in 2007, this is also greater than the standard but it seems abnormal increment and an indicator that most of the current assets are borrowed assets; specifically, cash. In this regard, the union has looked at the main sources of their current assets and can be supported by solvency indicators.

Conclusion

This study has taken the PEARLS model to evaluate the financial performance of the Waltane SACCOs Union, in the West Shoa zone. The study employs secondary data ratios in analyzing the union's financial performance.The study result provides that the financial performance of the union was best in areas such as protection, asset quality, and the sign of growth. On another side, the result states that the union was good in areas like effective financial structure and rates of return & cost. Whereas, the study also reveals that the union's performance was bad regarding liquidity since the majority of the resources are from external sources.

Recommendations

As the result reveals that P1, P3, and P6 all are up to the standard that has sated by WOCCU the union should keep this maintainable and make safe the money of the members without incurring risk. The primary objective of evaluating protection is to ensure that the financial institution provides depositors a safe place to save their money.

As far as the indicators of effective financial indicators are concerned the study used E1, E3, E5, E7, and E9 to measure the profitability of the union. As per the result, E3 and E7 are in a good position and within the standard. The union shall keep these ratios up to standard as much as it can to maintain financial investments and members share capital. On the other hand, the study result shows that E1, E5, and E9 are fluctuating. Therefore, the union has to do more on areas like loans, saving deposits, and net institutional capital to increase them to the level needed.Assets quality is the main variable that affects institutional profitability. As we can observe it from the result, the quality of the assets of the union is in line with the standard of WOCCU and this should be kept for a life of the union since an extra of defaulted or delayed repayment of loans and high percentages of other non-earning assets have negative effects on credit union earnings because these assets are not earning income.

Profits and costs directly affect the growth rates of an institution. From the result, we recommend that the union has better preserve R2, R9, and R12, but the union has to pay very vigilant attention to R4 and R6 which are about non-financial income to average non-financial investment ratio and borrowed fund to average borrowed fund ratio. Because as non-financial investments and borrowed funds are enlarged profitability will be diminished. R8 of the union indicates the average value, so to bring it to the extent needed the union has to increase gross margin. The earning of the union from the total asset is not as expected, therefore, the union should raise it's earning in proportion to its total assets invested.Managing liquidity is an essential component of administering a savings institution. As far as Waltane SACCO union is concerned, liquidity measurements are destitute of all the results. The union has better take a very prodigious improvement on L1 and L2 which are about members' withdrawal and liquid reserves to savings deposit. Regarding L3, its relatively good while compared to two of the above but, a small arrangement is needed on this part to maintain non-earning liquid assets to total assets of the union.

Signs of growth reflect member-client satisfaction, appropriateness of product offerings, and financial strength. The union has used the sign of growth following the standard sated and the union has to excel that but, S6 has to be more emphasized to know exactly the growth in total current borrowed fund.

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Journal of Science and Sustainable Development (JSSD), 2021, 9(2), 70-91

ISSN: 2304-2702 (print); 2414-4479 (online)
DOI: 10.20372/au.jssd.9.2.2021.0346

RESEARCH PAPER

Spatial Variability and Status of Selected Physico-Chemical Properties of Soil in Different Land Use Types: The Case of Kiramu District, East Wollega Zone, Oromia

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Abstract

Determining spatial variability and status of selected soil properties is important for the evaluation of agricultural land management practices and planning of sustainable soil management of specific land uses types. This research work was carried out in Kiramu district of Oromia Region, western Ethiopia to investigate spatial variability and status of selected physico-chemical properties of soils under different land uses. The natural forestland was used as control group to assess status of soil properties by comparing with the cultivated land, which was further stratified in to mid high land and semiarid land based on topography and climate. Representative soil samples (0-30)cm depth were collected randomly from each land uses and analyzed for the selected soil physico-chemical properties., The particle size distribution sand was the dominant fraction in all of the soil of the land uses and sand, silt, clay, bulk density and soil moisture content ranged from 51 to 65%, 15 to 23%, 18 to 28%, 0.96 to 1.38 g $cm^{-3}$and 5.28 to 17.95%, respectively. The soil pH varies from slightly acidic to strongly acidic (6.09 to 5.19, exchangeable Ca, Mg, K and Na respectively ranged from (6.61 to 13.98cmol (+) kg^{-1}), (2.67 to 6.30cmol (+)kg^{-1}), (0.27to 1.14cmol(+) kg^{-1})and (0.03 to 0.13cmol(+) kg^{-1}). Moderate to very high CEC (18.30 to 49.09cmol(+) kg^{-1}), low to moderate PBS (28.52 to 57.33%), low to high in OM (2.24 to 7.38%) and total N (0.11 to 0.37%), very low to low, Available P (2.35 to4.21) ppm and Available(6.78 to 18.06) ppm were recorded. Exchangeable acidity ranged from 0.07 to 1.41 while soil C: N ranged from 11.61 to 11.63. The coefficient variability of soil properties among the land use type were more pronounced in chemical properties than in physical properties. The spatial variability of soil properties indicates that they were strongly affected by natural and anthropogenic factors as well as soil management practices. It was recommended that there is a need for appropriate interventions and special attention to improve on land management practices for sustainable productivity of soils in different land use types in present study area.

***Key Words:** Kiramu district, land uses, management practices, soil properties, spatial variability.*

Introduction

In Ethiopia, agriculture is long-term capital on which the nation builds and grows (Sumner, 2000). It provides an employment to 85% of the population, contributes 90% of the total export earnings, supplies over 70% of the total raw materials required by industries and accounts for 60% of the country's gross domestic product (CSA, 2019 This indicates that agriculture is the main economic sector in the majority of the countries in the world and the world's population (Ahmed, 2002).In order to maintain the agricultural sector, determining spatial variability of soil based on their

physico-chemical properties is important for ecological modeling, sustainable agriculture and management of natural resources (Wang, 2009). Spatial variability is a term indicating changes in the value of a given property over space (Ettema and Wardle, 2002) Literatures revealed that the spatial characteristics of soils depend on climatic conditions topography, type of vegetation and land uses anthropogenic factors (Wang et al., 2009;Patilet al., 2010;Wangand Shao, 2013). Thus, having information on the spatial variability and the interactions between soil properties is essential for understanding these ecosystem processes and planning sustainable soil management alternatives for specific land use (Ziadat and Tamimeh, 2013). Furthermore, conversions of an area from natural ecosystem to cultivated land may be the reason of soil degradation and decreases of quality. Because, land uses have significant influences on soil quality indicators particularly at the surface horizons. Several studies also revealed, intensive cultivation and use of acid forming inorganic fertilizers for the past three decades in western Ethiopia affected soil pH, CEC, total N and OC, different forms of P and exchangeable bases. This implies that soil physical and chemical properties are strongly influenced by soil management systems and changes in land use types (Wakene and Heluf, 2003, Achalu et.al. 2012, Abraham et.al. 2019, Achalu and Teshome, 2019).

The soils of the present study area have been continuously cultivated and have great impact on the soil physical and chemical properties in different land uses types. Evaluating and investigating the status of land uses and management practices requires the knowledge of soil spatial variability and understanding the relationship of soil properties under different land uses. However, there is limitation of knowledge and detail information about spatial variability of soil physico-chemical properties and effects of conversion of natural ecosystem to cultivated lands that has been increasing in the recent years in the area. Hence, there is a critical need to investigate the soil physico-chemical properties in Kiramu District, East Wollega, Oromia zone, western Ethiopia.

Materials and Methods

Descriptions of Experimental Sites

The study was conducted at Kiramu district of East Wollega zone in Oromia National Regional State, western Ethiopia. It is located about 470 km away from Addis Ababa, and about 140 km north of Nekemte town, the zonal capital of East Wollega in the Nekemte-Bahir Dar main road.

According to ERA (2013) final ESIA Document for Nekemte–Bure project, the study area has two agro ecological zone arid (Gammoojjii) and due mid altitude agro ecology (Baddadaree) zone, which accounts about 42.7% and 57.3%, respectively. Similarly, its altitudinal difference ranging between 1500-2300 m.a.s.l., effective mean annual temperature between 15 - 20 oC, and its mean annual rainfall is in between 1000 to 1600 mm. The main economic activities of the study area are mixed farming system that includes animal rearing and cultivation. Crops mainly grown in the area are cereals (Maize and Finger millet), oil seed crops (Niger seed), and different types of horticultural crops. In addition to crop production, Cattle, Goats, Sheep and poultry are also the other income sources and wealth of farmers. According to ERA (2013), of soil naming, the dominant soils in the district are Dystric and Eutric-cambisols and Dystric, and Haptic Nitisols. Additionally, the soil type in the study area is that black cotton accounts 5%, Red clay 15% and lime accounts about 85%. According to Kiramu Agricultural Office (2017), an assessment of the land use in woreda showed that 0.97% of its land is forestland, 8.24% grazing land, 82.29% cultivated land and the remaining 8.5% includes non-cultivated water bodies, swampy and rocky mountain areas, different services and others. Nole wetland and Gurangoye forests (30 hectares) are some of the biologically important location in the Kiramu district.

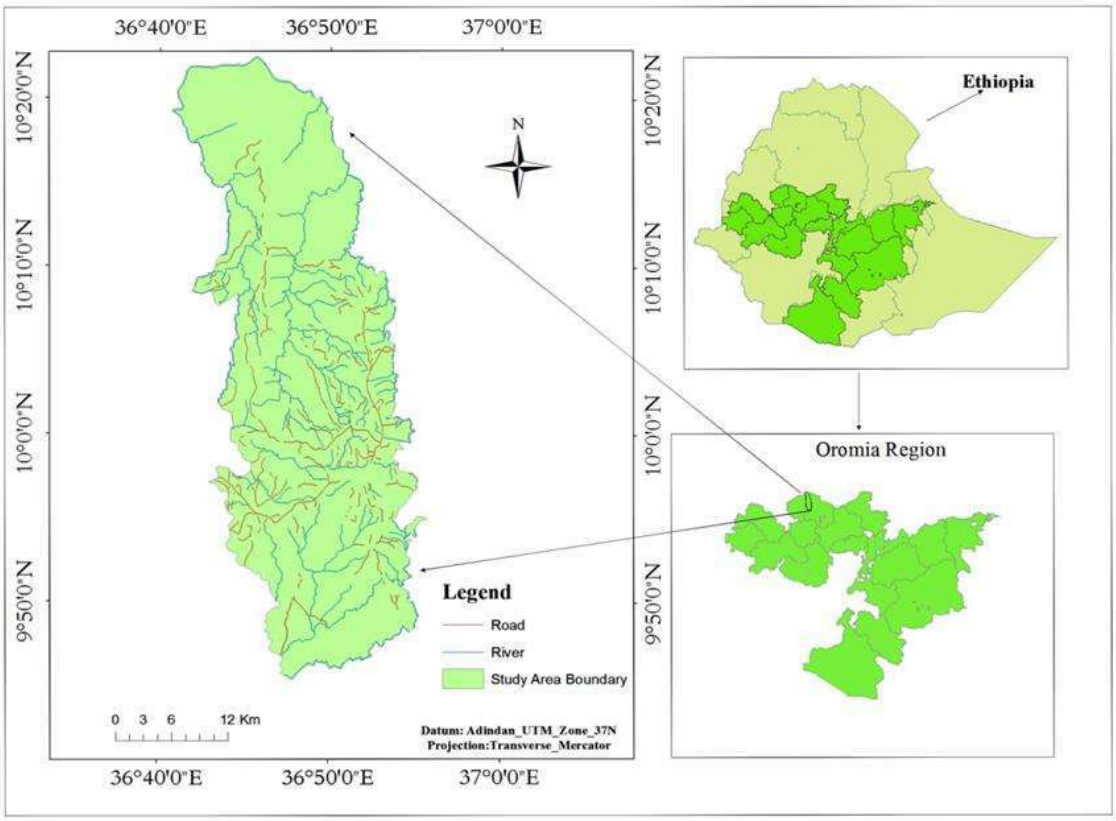

Figure1.General Location Map of the Study Area.

Sites Selection and Soil Sampling Technique:

Preliminary field observation and a reconnaissance soil survey with purposive sampling method were carried out to identify representative land use types, topography and climate in the district. Sampling sites was stratified in to two major representative land use types: cultivated land and natural forestland and cultivated land further classified in to mid altitude (*Baddadaree*) its altitudinal difference ranging between 1990-2211 m.a.s.l and semiarid (*Gammoojjii*) its altitudinal difference ranging between 1447-1535 m.a.s.l based on climate and topography (elevation) by using GPS. Forestland representatives' sample (Gurangoye and Gurawatino) covered with indigenous natural forest and can be used as a control group. Sampling procedure used wasfield based or directed soil sampling method in which 10-15 cores were taken from every 20 or more acres($\geq$ 80,000 m^2) of field (USDA - NRCS, 2017) and composite soil sample was performed by combining soil from several locations prior to analysis. Undisturbed core and disturbed composite surface soil samples at a soil depth of 0-30cm were collected from each representative land uses, by using soil augur in zigzag and random pattern. Then composite soil sample of about 1Kg was properly combined and prepared for each representative land uses and sealed with plastic bags together with a tag. Totally three composite soil samples were collected

Laboratory Analysis of Soil physical and chemical Properties:

The well-mixed soil sample was brought to the laboratory. The Soil samples collected were air-dried and ground to pass through a 2 mm size

sieve in preparation for the analysis of all soil properties except for soil OM and total N. For the analysis of soil OM and total N, the soil samples were further passed through 0.5 mm sieve. Determination of soil particle size distribution was carried out by the Bouyoucas hydrometer method as described by (Okalebo et al., 2002). Soil moisture content was determined by the gravimetric method that must consider the actual soil moisture content as described by (Sparks et al., 1996).Soil bulk density was measured from undisturbed soil samples collected using a core sampler, which was weighed at field moisture after drying the pre-weighed soil core samples to constant weight in an oven at 1050C as per the procedures described by(Black,1965).Total N was determined using the micro-Kjeldahl digestion, distillation and titration procedure as described by (Bremner and Mulvaney,1982).

Available P was analyzed using Olsen method as described by (Olsen and Sommers, 1982). Exchangeable bases (Ca, Mg, K and Na) were extracted using 1M NH4OAc solution at pH 7. The extraction of Ca and Mg ions were determined using AAS while K and Na were determined by flame photo meter as described by (Rowell, 1994). To determine the cation exchange capacity (CEC), the soil samples were firstleachedwith1M ammonium acetate (NH4OAc), extracted (ammonium ion standard) soil samples with 10% NaCl solution. The amount of ammonium ion in the percolate was determined by the Kjeldahl procedure and reported as CEC (Hesse, 1972).Total exchangeable acidity was determined by saturating the soil samples with 1M KCl solution and titrated with 0.02M HCl as described by (Rowell,1994). The effective CEC is calculated as the sum of exchangeable bases and exchangeable acidity, the percent acid saturation (PAS) was calculated as the ratio of the exchangeable acid and as percentage of CEC. The percent base saturation (PBS) was computed from the sum of the exchangeable bases (Ca, Mg, K and Na) as percentage of CEC (Baruahand Barthakur, 1997). Finally, Ca/Mg and Mg/K ratios were calculated by computation.

Data Analysis

Data analysis was carried out using SPSS statistics version 20 and subjected to Analysis of Variance (ANOVA) following the General Linear Model (GLM) procedure of Statistical Analysis System (SAS) version 9.2 (SAS, 2008) Pearson's simple correlation coefficient and significant means were separated using Least Significant Difference (LSD) at < 0.05 and < 0.01) was used to compare and separate for significant means.

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Results and Discussion

Status of Selected Soil physical Properties of Different Land Use Types

Particle size distribution analysis of the top soils (0-30 cm) from the present study area revealed that sand was dominant fraction (51-65%) in all of the land use types (Table 1). This was followed by silt (23%) and clay (18%) in forestland whereas it was followed by clay and silts for cultivated mid high land and cultivated semi-arid land (Table 1). According to Hazelton and Murphy (2007), the soils of the study area are characterized by low-level of clays in forestland and cultivated mid high land, moderate level of clay in cultivated semi-arid land, while low level of silt and very high level of sand in all land use types. The lower level of clay fractions in both forest land and cultivated mid high land of top soil might have been attributed to relatively higher rate of down ward erosion or destruction of clay in the top soil (Siddique et al., 2014) and slow rate of weathering process. The moderate level of clay fraction in cultivated semi-arid land might be due to the climatic variation that is supported

by the observation of Agoumé and Birang(2009) that reported a significant difference on the clay, silt and sand fractions of the soil and attributed the differences to variations in climatic condition. There was non-significant difference on soil particle size distribution of the soil with respect to land use. This suggests that the different land use types did not have effect on the soil texture of the study area, since texture is an inherent soil property that not influenced in short period of time. Similarly, Shepherd, et al.(2000) reported that non- significant effect of land-use systems on soil particle size distribution. Following the particle size distribution, the textural class of the study area were sandy loam in top (0-30 cm) soil of the forestland and cultivated mid high land that indicating the homogeneity of soil forming processes and their similarity in parent material(Foth,1990) while sandy clay loam in cultivated semi-arid land(Table 1).The high sand fraction in the study locations could be attributed the parent material dominant in the area, which is sand since the texture of the soil is highly influenced by the parent material over time (Oguikeand Mbagwu, 2009). Negatively and significantly relationship of clay with sand (-0.67) fractions were observed, however negative and insignificant correlation of clay with silt (-0.03) fractions were observed.

Table 1.Measured mean Values of selected soil physical properties in different land use types of the study area.

Depth	Land uses	Parameters						
		Sand	Silt	Clay	St :Cy	Texture	SMC	BD
0-30 cm	FL	59	23	18	1.28	SL	17.95	0.96
	CMHL	65	15	20	0.75	SL	5.29	1.10
	CSAL	51	21	28	0.75	SCL	17.63	1.38

FL=forestland; CMHL=cultivated mid high land; CSAL=cultivated Semi-arid land; BD=bulk density; SMC=soil moisture content; SL=sandy loam; SCL=sandy clay loam; St: CY=silt to clay ratio.

Silt clay ratio in the top soil (0-30cm depth) was low and 1.28, 0.75 and 0.75 for soils of forest, cultivated arid and cultivated mid altitude land, respectively (Table1).Relatively higher clay fraction and lower silt to clay ratio recorded in the cultivated land of both locations is attributed to the impact of deforestation and farming practices. This finding is in agreement with Achalu et al.(2012)who reported that due to difference in management practices and selective erosion in cultivated land resulted higher clay fraction in the cultivated land than the remaining land use system. The soils under different land use types and location differed in their soil moisture content. The variation may be due to difference in their organic matter content, which is lowest (5.29%) in cultivated mid high land and highest in forestland (17.95%) (Table1). In line with Ebtisam and Dardiry (2007) mentioned in (Achalu et al, 2012) that attributed the variation in SOM and clay contents of land uses. The soil moisture content was highly positively and significantly relationship with silt (0.77*), CEC (0.81**) and OM (0.78*).

The bulk density value of top (0-30cm) soil ranged from 0.96g/cm3, 1.10 g/cm3 and 1.38 g/cm3 in forest, cultivated mid high land and cultivated semi-arid land, respectively (Table 2).The lowest bulk density observed in soils of the forest land could be attributed to the high organic matter contents as was reported by Eyayu et al. (2009); Mojiri et al. (2012). In addition, the bulk density of the studied forest soils was fallen with the specified range as was suggested by White (1997) who revealed that bulk density is < 1 g cm-3 in high organic matter soils and largely affected by land uses.

Thus, the mean value of bulk density of the soils of cultivated semi-arid cultivated mid highland increased by 43.5% and 15%, respectively from the soils of forest land (Table2).

Table 2.Variability in soil physical properties among different land uses. (Mean±SE)

Land use types		soil physical properties					
		Sand	Silt	Clay	St: Cy	BD	SMC
Forest land		59.00	23.00	18.00	1.28	0.96	17.95
Cultivated mid high land		65.00	15.00	20.00	0.75	1.10	5.29
Cultivated semi-arid land		51.00	21.00	28.00	0.75	1.38	17.62
TOTAL	Range	22	13	17	1.08	0.45	14.84
	Mean	58.33	19.67	22.00	0.93	1.16	13.62
	Std. error	2.74	1.47	1.84	0.11	0.06	2.12
	Std. deviation	8.22	4.42	5.52	0.33	0.17	6.35
	LSD (0.05)	0.29	0.44	0.52	0. 92	0 .02	0 .76
	CV (%)	**14.09**	**22.47**	**25.09**	**35.48**	**14.66**	**46.62**

The high bulk density recorded in cultivated semi-arid land could be attributed to difference in parent material, soil type, climate and topography. This is in line with Reuter et al.((2005) reported that bulk density and temperature significantly higher at lower elevations. The overall bulk density showed negative but not significant correlation with soil OM (-0.38).Thus, the study indicated that as the organic matter increases the bulk density of soil decreases that is required for the proper growth of the plants. In agreement with the findings, Pravin et al. (2013) indicated inverse relationship between soil organic matter and bulk density of soil horizons.

Status of Selected Soil Chemical Properties of Different Land Use Types:

The average surface soil (0-30cm) pH-H2O values of the soils were 5.19, 5.64 and 6.09 in cultivated semi-arid land, forest land and cultivated high land respectively (Table 3). According to Tekalign (1991) the pH-H2O range of the studied soils results showed that the soils were slightly acidic, moderately acidic and strongly acidic in cultivated mid high land, forest land and cultivated semiarid land, respectively. The lower pH at the surface layer of the forestland than cultivated mid high land could be the presence of higher content of organic matter in the soil. The lowest pH value in soils of the cultivated semi-arid land could be attributed to the removal of basic cations by harvested crops and surface runoff, the use of fertilizers especially those supplying nitrogen, higher microbial oxidation that produces organic acids, which provide H+ to the soil solution and, thereby, lowers soil pH. This is in agreement with Busari et al. (2005) who explained in warm humid climate, it is likely to be thoroughly oxidized, well leached, and comparably low calcium because of leached out and due to the amount of materials removed at previous harvests, amount and type of fertilizer normally used. In line with this finding, the least significant difference ($p \leq 0.05$) test showed significant differences in pH-H2O between cultivated mid high land and cultivated semi-arid land use types. Thus together with climate, the nature and properties

of parent materials are the most significant factors influence the pH value of the soil.

Table 3. Measured mean values of pH (H2O), pH (KCl), Ex. Al and PAS in different land uses of the study area.

Depth	Land uses	Soil Chemical parameters				
		pH- H2O	pH -KCl	ΔpH	Ex. Al.	PAS
0-30 cm	FL	5.64	4.48	1.16	0.07	0.34
	CMHL	6.09	4.61	1.48	0.12	1.09
	CSAL	5.19	3.92	1.27	1.41	10.24

FL=forestland; CLMHL=cultivated mid high land; CSAL=cultivated semi-arid land; Ex. Al=exchangeable acidity; PAS=percent of acid saturation.

In all of the identified land use types of the representative soil, soil pH-H2O values were consistently greater than the pH-KCl by about 1.16 to 1.48 units(Table 3), indicating the existence of net negative charges on the exchange complex. The lower soil pH-KCl values could also indicated the presence of substantial quantity of exchangeable hydrogen ion as outlined by Mulugeta and Sheleme (2011). This is related to the presence of weather able minerals in the soil that indicated high potential acidity (Heluf and Wakene,2006).It was also explained differences between pH-H2O and pH-KCl higher than 1.0 indicated that an acidification process is in progress in all studied soils (Ozgoz et al., 2013).

Exchangeable Acidity and Percent of Acid Saturation:

There was great variation on exchangeable acidity and acid saturation of the soils under the different land use types of topsoil (0-30cm). The highest exchangeable acidity value obtained from soils of cultivated semi-arid land (1.41) and followed by cultivated mid high land (0.12). The high soil exchangeable acidity in the cultivated semi-arid land might be associated with the occurrence of lower soil pH. Reports also indicated that exchangeable acidity is a function of soil pH composed of compounds such as Al(OH)2+ and weak organic acid ions held at the colloidal surfaces of the soil (Hinrich et al., 2001). Strong negative correlation (r = -0.67) between exchangeable acidity and soil pH (Table 6). Significant ($p \leq 0.05$) differences in exchangeable acidity among the land use types. Relatively, the highest acid saturation were recorded in cultivated semi-arid field (10.24%) and followed by cultivated mid high land (1.09) whereas the lowest was in forestland (0.34) that showed similar trend with Ex.Al (Table 3).

Table 4.Variability in pH, EC, Ex.A and PAS among different land uses of the study area. (Mean ±SE)

Land use types		Soil Chemical Parameters			
		pH-H_2O	pH-KCl	Ex. Al	PAS
FL		5.64	4.48	0 .12	0 .34
CMHL		6.09	4.61	0 .07	1.09
C SAL		5.19	3.92	1.41	10.23
TOTAL	R	5.19-6.09	3.92-4.61	0.07-1.41	0.34-10.23
	X	5.64	4.34	0.53	3.82
	SE	0.17	0.21	0.22	1.700
	SD	0.51	0.64	0.67	4.83
	LSD (0.05)	0 .20	0 .81	0 .64	0 .78
	CV (%)	**9.04**	**14.75**	**126.64**	**126.64**

FL=forestland; CLMHL=cultivated mid high land; CSAL=cultivated semi-arid land; Ex.Al = exchangeable acidity; PAS = percent of acid saturation; R=range; X=Mean; SD=standard deviation;

In general, the differences in level of acid saturation at both locations of cultivated land more probably due to topographic condition, the management factor and the intrinsic character of the soils. There was a less significant ($p \leq 0.05$) difference in acid saturation among the land use types. Strong positive correlation of exchangeable acidity with PAS (0.99**) while strong negative correlation with PBS (-0.80*) The inverse relationship of exchangeable acidity and PAS with PBS could be due to deforestation and intensive cultivation, which leads to the higher exchangeable acidity content in soils of cultivated lands than the other land use (Baligar et al., 1997; Achalu et al., 2012).In general, the highest status of acidity on cultivated semi-arid field indicated the marked influence of tillage activities, soil parent material and removal of basic cations by crop uptake whereas the better soil condition on cultivated mid high land soils signify the importance of agricultural management practices such as supplying animal manure, dung and crop rotation.

Exchangeable Bases, CEC and Percent of Base Saturation:

The exchangeable bases varied markedly due to differences in land use systems (Table 5).The highest total exchangeable bases (20.81cmol (+)/kg) was recorded on forestland soils followed by cultivated semi-arid land (12.37cmol (+)/kg) and cultivated mid high land soil(10.49 cmol (+)/kg).As per the ratings of FAO (2006), the exchangeable calcium (Ca) was high under forest land (13.98cmol (+)/kg)whereas moderate under cultivated mid high land (7.44cmol (+)/kg) and cultivated semi-arid land (6.61cmol (+)/kg). The exchangeable Mg was high under forestland(6.30cmol (+)/kg) and cultivated semi-arid land(4.59cmol (+)/kg) while moderate under cultivated mid high land (2.67cmol (+)/kg).The exchangeable K was low, moderate and high in soils of cultivated mid high land(0.27cmol (+)/kg), forestland(0.41cmol (+)/kg)and cultivated semi-arid land(1.14cmol (+)/kg), respectively while the exchangeable Na was low under all land use types (Table5). Concentrations of

exchangeable cations in the study area were generally in the order of Ca>Mg>K>Na (Table 5). This might have resulted from the strong energy of adsorption of Ca, making it typically more abundant as an exchangeable cation than are Mg, K or Na (Foth, 1990). The finding was in line with (Bohn et al., 2001) who reported Ca followed by Mg, K and Na, indicating productive agricultural soils, dominated the exchange complex.

Table 5.Measured mean values of exchangeable cations and exchange properties of soil in different land uses of the study area (0-30 cm).

Land uses	Parameters									
	Ex.Ca	Ex.Mg	Ex.K	Ex .Na	TEB	CEC	ECEC	Ca/Mg	Mg/K	PBS
	----------cmol(+)kg^{-1}----------							-------ratio------		(%)
FL	13.98	6.30	0.41	0.13	20.81	49.09	20.88	2.22	15.48	42.39
CMHL	7.44	2.67	0.27	0.11	10.49	18.30	10.61	2.79	9.92	57.33
CSAL	6.61	4.59	1.14	0.03	12.37	43.36	13.78	1.44	4.01	28.52

FL=forestland; CMHL=cultivated mid high land; CSAL=cultivated semiarid land; Ex.Ca=exchangeable calcium; Ex. Mg=exchangeable magnesium; Ex.K=exchangeable potassium; Ex.Na=exchangeable sodium; TEB=total exchangeable bases; CEC=cation exchange capacity; ECEC=effective cation exchange capacity; PBS=percent of base saturation.

Compared to cultivated land the relatively higher concentrations of exchangeable Ca, Mg, and Na contents recorded in soils of forestland (Table 5) could be due to crop harvest, erosion and leaching of basic cations from top soils of cultivated land. The highest content of Ca2+in forestland might be attributed to leaves from plant falls and microbial activities common in this land use. The concentration of exchangeable Mg2+in the land use was higher (sufficient) than the critical level of 0.5 cmol/kg soil as suggested by (Landon, 1991); a concentration less than this value would require an application of magnesium limestone accordingly. The total exchangeable bases decline in cultivated mid high land might be showing the high concentration of the Fe2+ ions in the soil. Similarly, He et al. (1999) reported that domination of soil by extractable Al3+ and Fe2+ ions in the top soils of cultivated land resulted in relatively lower contents of Ca and Mg ions in the soil. In addition it might be related to intensive and continuous cultivation, high level erosion and removal of base cations during crop harvest that enhanced the depletion of soil nutrients.The higher concentration of exchangeable K in soils of cultivated semi-arid land might be due to the presence of wood ash in the soil. However, the lowest value of exchangeable K in cultivated soil of mid high land might be related to intensive cultivation, erosive nature of the soil (sandy soil), and removal of base cations during crop harvest that enhanced its depletion. Therefore, in cultivated fields of mid high land, it is deficient (0.27cmol(+) kg-1) when compared to 0.38cmol (+) kg-1 which is established to be critical level of exchangeable K for most crops (Barber, 1984).This is contrary to the old-age generalization that Ethiopian soils are rich in K. Also, Heluf and Wakene (2006) observed that continuous and intensive cultivation and use of acid forming inorganic fertilizers affected the distribution of K in the soil and enhanced its depletion. Similarly, exchangeable sodium was almost negligible in all land use types. This might be because of the small energy of adsorption of Na, it is more likely exist in the soil solution and be removed from the soil by leaching (Foth, 1990).More over since the concentration of exchangeable Na+ did not exceed 1cmol (+)/kg soil (Landon, 1991), the soil in the study area would not be regarded as sodic soil. The pH also showed that the soil is acidic. Thus, the concentrations of basic cations in the soil provide a very good assessment of soil fertility because individual cations are an indication of nutrient status and balance (Siddique et al., 2014).Significant

(p≤0.05)differences in total exchangeable bases among the land use types and forest soils had significantly higher exchangeable bases (p<0.01) than soils under the cultivated land use types of both locations. Generally, variations in the distribution of exchangeable bases depends on the mineral present, particle size distribution, degree of weathering, soil management practices, climatic conditions, degree of soil development, the intensity of cultivation and the parent material from which the soil is formed (Heluf and Wakene, 2006).

Table 6. Variability in exchangeable cations and exchange properties of soil among different land uses of the study area (mean±SE)

Land use types	Parameters								
	Ex.Ca	Ex.Mg	Ex. K	Ex. Na	TEB	CEC	ECEC	Ca/Mg	PBS
FL	13.98	6.30	0.41	0.13	20.81	49.09	20.93	2.23	42.6
C MHL	7.44	2.67	0 .27	0.11	10.49	18.30	10.56	2.87	57.77
CSAL	6.61	4.59	1.14	0.03	12.37	43.36	13.78	1.45	28.70
TOTAL R	9.06	4.49	1.05	0.14	11.58	37.06	11.61	1.98	41.18
TOTAL X	9.34	4.52	0.61	0.09	14.56	36.92	15.09	2.18	43.02
TOTAL S E	1.19	0.54	0.14	0.02	1.61	4.81	1.56	0.24	4.46
TOTAL SD	3.56	1.63	0.41	0.05	4.83	14.42	4.68	0.71	13.38
TOTAL LSD (0.05)	0 .23	0.01	0.10	0.35	0.05	0.06	0.01	0.10	0.02
TOTAL CV (%)	38.12	36.06	67.21	55.56	33.17	39.06	31.01	32.57	31.10

FL=forest land; CMHL=cultivated mid high land; CSAL=cultivated semiarid land; R=range; X =mean; SE =standard error; SD =standard deviation;

The average values of cation exchange capacity were 49.09cmol (+)/kg for soils of forestland, 43.36cmol (+)/kg for soils of cultivated semi-arid land and18.30cmol (+)/kg for soils of cultivated mid high land (Table5). According to the rating suggested by Hazelton and Murphy (2007), the mean CEC value of the soils of the study area ranged from moderate for soils of cultivated mid high land (18.30cmol (+)/kg) to very high in soil of forest land (49.09cmol(+)/kg) and cultivated semi-arid land (43.36cmol(+)/kg).The soils of forestland and cultivated semi-arid land have higher CEC than soil of cultivated mid high land probably because of the presence of higher organic matter contents of the land use types. This is in agreement with Adeboye et al.(2011); Yihenew and Getachew (2013) who indicated that high organic matter and clay contents increase CEC in soils. Also, McAlister et al. (1998) justified that CEC of soils varies with the changes of clay percentage, the type of clay, soil pH and amount of organic matter. The observed reductions in the mean soil CEC values of the considered land use types due to conversion of forest lands into cultivated lands accounts 11.69% (for cultivated semi-arid land) and 62.73%(for cultivated mid high land), respectively in top soils of the study area (Table 5). This showed that the soil CEC values in the cultivated land uses of both locations decreased mainly due to the reduction in OM

content. In agreement with this, strong positive and significant correlation (0.86**) of CEC with soil OM. Similarly, significant ($p \leq 0.05$) differences in CEC among the land use types. Thus, the findings of the present study concur with Woldeamlak and Stroosnijder (2003) who reported highest CEC value in soils of forestland and lowest under cultivated land.

Following the variation in exchangeable bases and cation exchange capacity, the base saturation percentage (PBS) of the soils in the study area showed considerable variability among the land use types (Table 5).Accordingly the highest PBS was recorded under cultivated mid high land field (57.33%) followed by forestland (42.39%) and cultivated semi-arid land (28.52). As per rating of Hazelton and Murphy (2007) PBS content of the studied soils was moderate under forestland (42.39) and cultivated mid high land (57.33) whereas low under cultivated semi-arid land(28.52) . According to Landon (1991), soils having greater than 60% base saturation are rated as fertile and potentially productive soils. The Ca to Mg ratio in the three land use types (Table 5) was low with values ranging from 1.44-2.77when compared with a normal range of 3.1-5.1 for productive soils. This ratio indicated that the Ca content in the soil solution is low when compared to the Mg content irrespective of the land use type. On the other hand, the Mg/K contents were high (>1.2) with values ranging from 4.01 (cultivated semi-arid land) to 15.48 (forestland) when compared with a critical level of 1.2 for productive soils (Landon, 1991).

Organic Matter, Total Nitrogen and Carbon to Nitrogen ratio:

The organic matter (OM) contents were 7.38, 4.20 and 2.25%in the soils of forestland, cultivated semi-arid land and cultivated mid high land respectively (Table 7). As compared to the soil of forestland, the amount of soil OM in cultivated mid high land and cultivated semi-arid land has depleted by 69.59 and 56.87%, respectively (Table 4). As per the rating of Tekalign (1991) the OM contents of the soils in forest, cultivated semi-arid land and cultivated mid high land use types were rated as high, moderate and low, respectively. Higher quantity of OM in forestland soil is mainly due to the addition of more plant residues on its surfaces, as compared to the cultivated land use types of both locations.

The low content of organic matter in the cultivated mid high land fields might be associated with increased rates of mineralization of OM mainly caused by the continuous and intensive tillage activities, increased soil temperatures due to exposure of the soil surface, and the removal of plant residue. The result was in agreement with Yihenew and Getachew (2013) who reported that lowest organic carbon was registered in cultivated land and highest in the natural forestland. Continuous and intensive cultivation reduced the organic matter content of the soil to a larger extent and increasing SOM decomposition rates, as reported by Gebyaw (2015). Forest clearing followed by conversion into grazing and agricultural land uses in tropical ecosystems brought about remarkable decline of the soil OM stock (Achalu et al., 2012).

Table7. Measured mean value of organic matter, total N, available P and available K of soil in different land uses of the study area.

Depth	Land uses	Parameters					
		OC (%)	OM (%)	TN (%)	C/N	Av.P Olsen(ppm)	Av.K (ppm)
0-30 cm	FL	4.28	7.38	0.37	11.61	2.36	6.78
	CMHL	1.30	2.25	0.11	11.63	4.21	6.95
	CSAL	2.44	4.20	0.21	11.60	2.35	18.06

FL=forest land; CMHL=cultivated mid high land; CSAL=cultivated Semi-arid land; OC=organic carbon; OM=organic matter; C/N=carbon nitrogen ratio; Av. P=Available phosphorus; Av. K=Available potassium

Also, Yihenew (2002) reported that most cultivated soils of Ethiopia are poor in their organic matter content due to low amount of organic materials applied to the soil and complete removal of the biomass from the field. Soil OM contents under the land use types were significantly ($p \leq 0.05$) varied. In general, the highest organic matter content was recorded at the surface layer of the natural forestland soils, while the lowest was observed on the cultivated land soils. In line with the variations in OM content, total nitrogen also exhibited some degree of variability among soils of the land use types. Consequently, the total N content in the surface of the soils of the study area were: 0.37% for soils of forest land, 0.21% for soils of cultivated semi-arid land and 0.11% for soils of cultivated mid high land (Table 7). According to Tekalign (1991), the total N content of the soils is categorized under low for soils of cultivated mid high land, medium for soils of cultivated semi-arid land and high for soils of forest land.

Table 8.Variability in organic matter, total N, available P and available K of soil among different land uses of the study area (mean±SE).

Land use types		OM (%)	TN (%)	C: N	Av. P (ppm)	Av. K (ppm)
Forest land		7.38	0.37	11.63	2.36	6.78
cultivated mid high land		2.25	0.11	11.62	4.21	6.95
cultivated semi-arid land		4.20	0.23	11.63	2.35	18.06
TOTAL	Range	6.04	0.30	0.05	2.40	13.49
	Mean	4.61	0.23	11.63	2.97	10.60
	SE	0.77	0.04	0.01	0.32	1.89
	SD	2.31	0.12	0.02	0.95	5.66
	LSD (0.05)	0.01	0.01	0.72	0.98	0.85
	CV (%)	50.10	52.17	0.17	31.99	53.40

The principal cause for lower contents of total N in the cultivated mid high land could be attributed to intensities of erosion, intensive and continuous cultivation, the N leaching problem, biomass removal during crop harvest and insufficient replenishment through manure or fertilizers. In consent with Bahami et al.(2010); Heshmati et al. (2011); Taye (2011);Mojiri et al. (2012) reported considerable loss of total nitrogen from soils following conversion of land from forest to cultivated land due to harvest removal, leaching, and humus losses associated with cultivation. In contrast, greater TN contents of the forest soils are probably due to decomposition, higher litter production and N fixation by the leguminous acacia species. This is in line with Hall (2008)explained that the highest total N under forestland might be because of decaying plant and animal matter and nitrogen compounds produced by thunderstorms. The trends of total N generally showing the strong relationship between OM and total N as indicated by the positive and

very highly significant (1.00**) correlation (Table 11), indicating the strong influence of organic matter on TN content. Therefore, organic matter (OM) and the TN were highly affected by the different land use systems particularly in the surface horizons. In consent with Meysner et al. (2006) indicated that as much as 93 to 97% of the total N in soils is closely associated with OM. In supporting of this finding, the least significant difference ($p \leq 0.05$) test has shown significant differences in OM and TN among the land use types.

The average carbon nitrogen ratio values recorded in the soil of the study area were 11.6, 11.61and 11.63 for soils of cultivated arid land, forestland and cultivated mid high land, respectively (Table 5).According to Brady and Weil (2008) the C: N ratio in soils of arable soils commonly ranges from 8: 1 to 15: 1 and the average is between 10:1 to 12:1. Thus, the obtained C: N ratio values of the soils could be considered within the range reported averagely 10:1 to 12: 1. In line with this, the C: N ratio was fall in the range of medium in all land use types of the study area (Gavilak, 1994). Relative to forestland, the narrow carbon to nitrogen (C: N) ratio at the cultivated semi-arid land may be due to the effect of higher microbial activity that result in relatively fast decomposition of OM due to increased temperature and more CO2 evolution than in the high topographic position. Regarding this, similar results were observed by (Abbasi et al., 2007; Achalu et al., 2012). In line with this, correlation analysis has also shown positive ($r = 0.20$) of C: N with OM.

Available Phosphorus and Available Potassium:

The concentration of available phosphorus recorded in the soils of the study area under different land use were4.21ppm (the highest) under cultivated mid high land, 2.36ppm for forestland and2.35ppm (the lowest) under cultivated semi-arid land (Table 7).The available phosphorus in the present study was very low under forest land and cultivated semi-arid land while low under cultivated mid high land(Havlin et al.,1999).Tekalign and Haque (1991)also supported this finding by indicating that the critical values for Olsen P were established to be 8.5ppm for some Ethiopian soils. Consequently, the available P concentration of the soils in the study area was below the critical level, which exist in low proportions and it is below the requirements even for the low demanding crops. Even though the OM content of the cultivated mid high land was lowest, Av.P content was highest under the cultivated mid high land than the other land use types relatively. This could be due to the application of animal manure and Di-ammonium phosphate (DAP) fertilizer on the cultivated mid high land in line with the explanation made by Woldeamlak (2003); Gebeyaw (2007).The very low available P status in the cultivated semi-arid land and forestland soils could be associated with the low pH, high exchangeable acidity and phosphorus fixation. Hence, these soils with relatively high exchangeable acidity can have the acidic cations such as exchangeable Al, H, and oxides of Al and Fe that could fix the soluble P in the soil solution. Positive correlation (0.61) of available P with soil pH but negative correlation (-0.50) with soil exchangeable acidity (Table 11).To summarize the Available P deficiency in soils of the study area may be due to the inherent low-P status of the parent material and erosion loss. Gebeyaw (2006) also reported that the Available P in most soils of Ethiopia is low due to P-fixation, crop harvest, and erosion by water.

Available K significantly varied with land use types, higher in soil under the cultivated semi-arid land (18.06ppm) followed by the cultivated mid high land (6.95ppm) and forestland (6.78ppm) use types (Tables 7and 8). As described by Marx et al.(1996) the available Potassium in all land uses were below the critical level (<150ppm).Relatively, the lowest available Potassium was registered on forestland could be probably due to soil losses by leaching and lower levels of Av. K in sandy soils. The observed highest concentration of Available K under the cultivated semi-arid land was attributed to relatively high in clay and organic matter and the burning of wood, which resulted in, increased of the available K.

Variability in Soils

Physico-Chemical Properties: The results in (Table 2, 4, 6, 8, 9 and 10) showed the variation of the physical and chemical properties of the soil among the different land uses. As a standardized measure of the variance, the coefficient of variation (CV) was used to describe the shape of a frequency distribution of the observation (Nielsen and Wendroth, 2003).Variation among soil physical properties of the different land use types were summarized and presented using coefficient of variation in Tables 2 and 9.

Table 9.Variability of physical properties among different land uses of the study area

No	Group	CV (%)	Soil physical properties
1	Least variable	< 15	sand and bulk density
2	Moderate variable	15-35	silt and clay
3	Highly variable	> 35	silt clay ratio and soil moisture content

According to (Wilding, et.al., 1994) coefficient of variance (CV) ranking (Table 9) the soils of the study area indicated that silt- clay ratio and soil moisture were the highly variable soil physical properties, observed silt and clay fractions were moderately variable, whereas sand and bulk density were the least variable among different land uses. The results in Tables 4, 6, 8 and 10 showed the variation of the chemical properties of the soil among the land use types. According to Wilding, et al.(1994) coefficient of variance (CV) ranking (Table 10) the soils of the study area analyses revealed that pH (H2O), pH (KCl) and carbon-nitrogen ratio had the least variation (CV<15%). Similarly, Sun et al.(2003)documented that pH the least CV. In addition, previous researches also depicted low coefficients of variation for pH compared to the other soil properties (Abu and Malgwi,2011).

Table 10.Variability of chemical properties among different land uses of the study area.

No	Group	CV (%)	Soil chemical properties
1	Least variable	< 15	pH (H_2O), pH (KCl),C/N
2	Moderate variable	15-35	EC, TEB, ECEC, Ca/Mg, PBS, Av. P
3	Highly variable	> 35	Ex. A, PAS, Ex.Ca, Ex. Mg, Ex. K, Ex. Na, CEC, clay (CEC), Mg/K, OM, TN,Av. K

The moderately variable soil chemical properties with CV (15-35%) were: EC, TEB, ECEC, Ca/Mg, PBS and Av. P; whereas, the highly variable soil chemical properties with CV>35% were: Ex.A, PAS, Ex. bases (Ca, Mg, K, Na), CEC, Mg/K, OM, TN and Av. K among the different land use types of the study area (Table 10). These are mostly properties that can easily be altered by varied land use types and management practices occurring within the study area. Similarly, Udoh et al. (2007) reported the significant variability in some soil physicochemical properties due to influence of land use, cultural and management practices. Generally, variability of soil properties among the land use types were more pronounced in chemical properties than in physical properties. The least varied physical property was found to be sand (CV=14.09%) and C: N ratio (CV=0.17%) had least variability in chemical properties (Table 2). The physical and chemical properties that had the highest variability within the soils are SMC

(CV=46.62%) and PAS (CV=126.44%), respectively (Table 9 and 10).

Relationships of Soil Physico-Chemical Properties: This relationship among the soil physico-chemical properties with different land uses in pearson correlation matrix (Table 11). The clay content had a significant positive correlation with BD (0.82**), Ex. A (0. 83**), PAS (0.85**), Av.K (0.83**) and Ex. K (0.78*) and negatively significantly correlated with sand(-0.67*) fractions and Ex. Na (r= -0.82**), however, negatively non-significant relationship with silt (-0.03), pH-H2O (r=-0.67), Ex.Ca (r= -0.59) and PBS (r=-0.62). The silt had a significant positive correlation with SMC(0.77*), Ex. Mg (0.77*), CEC (0.86**),TN (0.71*) and OM (0.72*)and insignificant positive correlation with EC(r=0.63) and TEB(r=0.59).However it had significant negative correlation with Av. P(-0.86**) and non-significant positive relation with PBS(r=-0.63).Sand fraction had positive and significant correlation with pH-H2O (0.84**)and PBS (0.69*), however positive non-significant correlation with porosity(0.50),Ex. Na (0.58) and Av. P(0.50). Moreover, it had negatively and significantly relationship with Ex. K (-0.70*), Ex. A(-0.68*), PAS(-0.68*) and Av. K (-0.65*), however negatively insignificantly related with BD (-0.50), SMC (-0.58) and CEC (-0.50). Significant negative correlations of bulk density with Ex.Ca (-0.75*) and Ex. Na (-0.94**), however, significant positive correlation with clay (0.82**), Ex. K (0.88**), Av. K (0.94**), Ex. A (0.94**) and PAS (0.94**) of soil as in (Table 11).While correlation between bulk density and pH-H2O (-0.52) was negative but not so significant. This is in line with Shaffer (1998) that observed highest correlation between pH and BD at 0 to 15 cm, but he did not indicate the reasons. From correlation analysis (Table 11) it was observed that soil moisture content highly positively and significantly relationship with silt (0.77*), EC (0.81**), Exch. Mg (0.87**), CEC (0.95**), TEB (0.66*), Ex. K (0.60*), OM (0.78*), however negatively and significantly related with Available P (-0.93**) and PBS (-0.79**).

The soil pH-H2O was positively significantly correlated with sand (0.84**), PBS (0.66*), available P (0.61*) and Ex.Na (0.72*) which indicated that availability of P and Na+ were dependent on soil acidity, however negative and significant correlation was observed with Ex. A (-0.67*), PAS (-0.67*), Exch. K (-0.69*) and Av. K(-0.62*). The EC had a positive significant correlation with silt (0.63*), SMC (0.81**), Ex. Ca (0.80**), Ex. Mg (0.92**), TEB (0.91**), CEC(0.86**) and OM(0.97**) and a negative significant correlation with Av. P(-0.72*).PAS had a significant positive correlation with clay (0.85**), BD (0.94**), Ex. A (0.99**), Ex.K (0.98**) and Av. K (0.99**) whereas a significant negative correlation with sand, (-0.68*), pH-H2O (-0.67*),Ex.Na(-0.94**) and PBS(-0.80**).Organic matter was correlated positively significantly with most of soil properties (Table 11) such as silt (0.72*), SMC (0.78Ex. Ca (0.84**), Ex. Mg (0.96**), TEB (0.95**), TN (1.00**) and CEC (0.86**) under different land uses. It, however, negatively significantly correlated with Av. P (-0.75*). Expectedly, OM was highly positively correlated with TN (1.00**), indicating the availability of nitrogen as influenced by the soil organic matter. Similarly, CEC was correlated positively significantly with most of the soil properties silt (0.86**), SMC (0.95), Ex. Mg (0.89**), TEB (0.73*) and OM (0.86**),however, it negatively significantly correlated with PBS (-0.77**) and Av. P (-0.95**). Ex.Ca was correlated positively significantly with EC(r=0.80*), TEB (0.96**) and OM (0.84**), while it was negatively significantly correlated with bulk density (-0.75**). Furthermore Ex. Mg was correlated positively significantly with silt (0.77*), SMC (0.87**), EC (0.92**), Ex. Ca (0.75**), TEB (0.91**), CEC (0.89**) and OM (96**), however negatively significantly correlated with Av. P (r= -0.81**).Av.P was correlated positively significantly with PBS (0.83**), however it correlated negatively significantly with Ex. K (-0.58*).Available K had positively significantly correlation with Ex. A (r= 1.00**) whereas it had negatively significantly correlation with Ex.Na (-0.92**) and PBS (-0.80**).In general, the correlation matrix analysis showed that Av. P, Av. K, pH, TN,

OM, CEC, PBS, SMC, EC, Mg+2 and Ca2+ are fundamental elements since they are significantly correlated with most of soil properties (Assefa and Van Keulen, 2009). The negative correlation of most of selected soil properties with clay and sand fraction may be attributed to the parent materials from which sand and clay fractions are formed (Thapa andYila, 2012).

CONCLUSIONS

The assessment of soil spatial variability is very important to know what and where proper corrective action and site-specific management is needed for future generation to sustain life. Particle size distribution of the soil revealed that sand was the dominant fraction (51-65%) in all of the soil of the land use types.. The bulk density value of top soil in the study area ranged from 0.96g/cm3, 1.10 g/cm3 and 1.38 g/cm3 in forest, cultivated mid high land and cultivated semi-arid land, respectively that showed variability with respect to land use type and location. The average pH-H2O values of the top soils were 5.19, 5.64 and 6.09 in cultivated semi-arid land, forestland and cultivated high land, respectively. The highest exchangeable acidity value obtained from soils of cultivated semi-arid land (1.41) and the lowest exchangeable acidity was registered in soils of forestland (0.07). The high soil exchangeable acidity in the cultivated semi-arid land could be associated with the occurrence of lower soil pH. With regard to exchangeable bases, Concentrations of exchangeable cations in the study area were generally in the order of Ca>Mg>K>Na. The CEC varied within a range of 18.30(for soils of cultivated mid high land) to 49.09cmol (+) kg-1(for soils of forestland) at the surface layers of the soil. Similar to exchangeable bases and cation exchange capacity, the base saturation percentage of the soils in the study area showed considerable variability among the land use types. The average carbon nitrogen ratio values recorded in the soil of the study area were varied from 11.60(cultivated arid land) to 11.63(cultivated mid high land). The C:N ratio was fall in the range of medium (average) in all land use types of the study area. The available P concentration was below the critical level, which exists in low proportions. Generally, as the comparison has been made among the land use types, the selected soil physico-chemical properties vary regularly and irregularly from place to place. The assessments made on spatial variability and status of selected soil properties from different land use types and topography, the variation is observed at surface layers of the soil as indicated by quantitative values discussed in the results and discussion section. The variation in soil properties caused by both intrinsic and extrinsic factors is resulted in variation to crop yield. Therefore, having the knowledge of spatial variability and status of selected soil properties is very important for sustainable farming, site-specific management and sustainable crop production.

Conflict of Interests:

The author declare that there is no conflicts of interest

Acknowledgments

The authors would like to thank the Department of environmental Science, Wollega University, for allowing us to undertake the research and for covering different expenses associated with the research works

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The value of a publication depends on its incremental contribution. Therefore, it is inappropriate to submit articles with substantial overlap. This overlap can result from the use of the same data or analyses or when providing parallel substantive or theoretical results. When there is a question about defining overlap, particularly that which arises from their own work, it is the authors' responsibility to notify and alert the editor. The Editor will make a binding decision whether a manuscript submitted to JSSD is too similar to an article already published there or elsewhere. When writing a paper, it is important for authors to define its incremental contribution by referencing relevant work on which the paper builds. Authors are expected to search for and reference the related work of others. Authors are especially responsible for informing the Editor about their own work, whether it is published, in working paper form, or under review. When questions arise about related work, the Editor will provide guidance to the authors. Submitting a paper that is substantially the same as a previously published paper is considered a serious breach of professional ethics and may warrant the Editorial Manager contacting officials at the authors' institutions of this breach. In the event that the author(s) is not affiliated with an institution, alternative steps may be taken, including a ban from submitting to JSSD.

c) Plagiarism

As defined by the Merriam-Webster dictionary, to plagiarize is "to steal and pass off (the ideas or words of another) as one's own," "use (another's production) without crediting the source," or to "present as new and original an idea or product derived from an existing source" (http://www.merriam-webster.com/dictionary/plagiarize). Ambo University considers other forms of plagiarism to include "self-plagiarism"—instances in which an author borrows from his or her own previously published work without the proper citation. It is also unacceptable to submit manuscripts to JSSD that have previously been published anywhere in any language. It is the authors' responsibility to inform or notify the Editor upon submission if there is any doubt whether a manuscript may violate any of these terms.

d) Detection, Investigation, and Penalty

In any instance of suspected misconduct, Ambo University pledges to carry out the process of detection, investigation, and penalty with fairness and confidentiality during the internal investigation. The process for detection, investigation, and penalty for suspected plagiarism is as follows:

i. Detection

The JSSD Editor, along with the Editorial Board and non–Editorial Board reviewers, will serve to detect instances of plagiarism. When an Editor suspects plagiarism (or is informed by a reviewer who suspects plagiarism), he/she shall make a judgment whether the claim has any merit. If the Editor determines that there has been potential misconduct, he/she shall inform the Director for Publication and Dissemination/Managing Editor and provide a detailed account of the possible violation or misconduct.

ii. Investigation

When informed by the journal Editor, the Director for Publication and Dissemination/Managing Editor shall determine whether further investigation is required. the Director for Publication and Dissemination/Managing Editor may choose to assemble a review committee of scholars to determine the exact nature and extent of the suspected misconduct. Each individual investigation may warrant the assembly of a new ad hoc committee. Any committee member who is perceived to have a conflict of interest must recuse him-/herself from the process. The Editor of the journal in question will not serve on the committee. If it is determined that an act of plagiarism has been committed, the Director for Publication and Dissemination/Managing Editor in consultation with the Vice President for Research and Community Service (VPRCS) will inform the author(s), in writing, with a detailed description of the alleged offense. The Director for Publication and Dissemination/Managing Editor shall offer the author(s) an opportunity to respond to the allegation. In events in which more than one author is involved, the authors may collaborate on their response or respond individually. If the committee concludes that no offense has been committed, no further action will be taken, and the Director for Publication and Dissemination/Managing Editor will inform the authors the same. If the committee determines that there has been misconduct, the process will move into a penalty phase.

iii. Penalty

In the event that an author (or authors) has been found to have engaged in some form of misconduct, he/she is to be subjected to a penalty. The nature and extent of the penalty will be determined by the VPRCS in consultation with the Director for Publication and Dissemination/Managing Editor and with the advice of the committee members. The penalty will be dictated by the nature of the offense and will likely include a ban on submitting to any journal published by Ambo University for a period of time. All sitting Editors of Ambo University journals will be informed. The committee is empowered to customize penalties for each individual in instances in which multiple authors are involved. In extreme circumstances, the Director for Publication and Dissemination/Managing Editor reserves the right to inform an author's institution, depending on the seriousness of the offense.

7. Resubmissions

Manuscripts that have been rejected are not eligible for further consideration by the same journal and thus should not be resubmitted. If a revision is allowed, it will be explicitly stated in the Editor's decision. Other revisions of previously rejected manuscripts will be promptly returned to the authors without review.

8. Conflicts of Interest

Conflicts of interest may arise in a variety of situations, and therefore the author is required to inform the editor of such conflict. A conflict of interest may exist when a manuscript under review puts forth a position contrary to the reviewer's published work or when a manuscript author or reviewer has a substantial direct or indirect financial interest in the subject matter of the manuscript. Because it is Ambo University policy to engage in a double-blind review process, a conflict of interest may also exist when a reviewer knows the author of a manuscript. The reviewer should consult the journal editor in such situations to decide whether to review the manuscript. A conflict of interest does not exist when an author disagrees with a reviewer's assessment that a problem is unimportant or disagrees with an editorial outcome.

9. Protecting Intellectual Property

Protecting intellectual property is a primary responsibility of the reviewer and the editor. Reviewers, therefore, will not use ideas from or show another person the manuscript they have been asked to review without the explicit permission of the manuscript's author, obtained through the journal editor. Advice regarding specific, limited aspects of the manuscript may be sought from colleagues with specific expertise, provided the author's identity and intellectual property remain secure.

10. Sharing of Reviewing Responsibilities

Sharing of reviewing responsibilities is inappropriate. The review is the sole responsibility of the person to whom it was assigned by the journal editor. Students and colleagues should not be asked

to prepare reviews unless the journal editor has given explicit prior approval. Each person contributing to a review shall receive formal recognition.

12. Review Process

All reviews will use a **double-blind peer review** process. Reviewers and journal editors are expected to provide comments and critiques in a confidential, constructive, prompt, and unbiased manner appropriate for their position of responsibility. Collegiality, respect for the author's dignity, and the search for ways to improve the quality of the manuscript should characterize the review process. The editor has the final authority for the acceptance or rejection of any article.

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