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Research Articles

Challenges of Irrigation Water Management on Smallholder Schemes: Case Study in Dembecha Woreda, Northwest Ethiopia

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Abstract

Smallholder irrigation has enormous potential to improve the incomes of poor rural households in developing countries like Ethiopia. However, numerous problems constrain irrigated crop production and irrigation water management efforts in many areas. In light of this, a survey was conducted with the objective of assessing the challenges of irrigation water management over smallholder schemes, in Dembecha Woreda (District), in the northwestern highlands of Ethiopia. Data were gathered through key informant interviews, group discussions, field observations and a questionnaire survey of 118 households. The data gathered were then analyzed using descriptive statistics; independent sample T-test and the Chi-square test. The results showed that irrigation water in the study area was distributed using rotation turns and the process was managed by an elected body of water users called irrigation water use committees. Over 63% of the respondents faced water shortages on their farms. Loss of water through seepage, poor coordination of water distribution by water use committees, water theft problems, water shortage at tail-end irrigators, absence of enforcing rules, water use conflicts, and rotation turn abuses were identified as major challenges of irrigation water management in the study areas. Hence, it is suggested that farmers be encouraged to harvest rain and underground water to stabilize water shortages and be provided with water management trainings.

Keywords: Smallholder irrigation, Water management challenges, Water use conflicts, Ethiopia

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1. Introduction

Agriculture plays decisive role in the economy of developing countries. The sector makes great contribution by providing food for human population, raw materials for domestic industries and export items to generate foreign exchange earnings. But, recently, climate change is impacting agricultural production through droughts and famines. Inconsistencies in temperature and rainfall trends cause droughts, pest infestations and crop damages in many areas. This necessitates proper and sustainable irrigation water management in affected areas. As a component of sustainable water management, irrigation has the potential to mitigate the negative impacts of variable rainfall and to stabilize agricultural production in such areas. Moreover, irrigation contributes to livelihood improvements through generating increased income, employment opportunity and poverty reduction (Asayehegn, et al., 2011). Proper irrigation water use and management is thus essential to minimize the impacts of agricultural water stress and to ensure sustainable social development (Dungumaro and Madulu, 2003).

Agriculture is the leading sector in the national economy of Ethiopia. It accounts for 48% of the Gross Domestic Product (GDP), 85% of the foreign exchange earnings and employs over 80% of the country's population (MoA, 2014). However, agricultural production in Ethiopia is primarily rainfed. It depends on unpredictable and often insufficient rainfall which results in frequent crop failure. Conversely, Ethiopia has enormous water resource potential that can be developed into irrigation (Makombe, et al., 2007) to complement the variable rainfall. Traditional irrigation has also been practiced in the country since ancient times. The small-scale traditional irrigation schemes that have been developed in the different regions of the country were also helpful in enhancing household food security and reducing the chronic poverty. Irrigation has thus the potential to stabilize agricultural production and mitigate the negative impacts of the variable rainfall in Ethiopia. Nevertheless, the existing irrigation schemes are not yet operating efficiently and the country continues to receive food aid from international donors.

Modern irrigation development in Ethiopia was started in the 1950s with the introduction of large-scale irrigation and hydroelectric power projects (Gebermedhin & Peden, 2002). However, most of the modern irrigation schemes are at micro level in size, serving households usually not exceeding 200 to 300 in number. Many of the schemes are based on stream and river diversions, whilst some are dependent on small dams and springs. Moreover, the existing smallholder irrigation schemes (both the traditional and modern ones) encounter

problems related to inefficient water use, seepage from canals, rotation turn abuses, siltation of dams, canal destructions, poor coordination of water distribution by water use committees (WUCs) and water conflicts. Besides, the irrigation development planning in the country puts huge emphasis on the agronomic, engineering and technical aspects of the water projects with little consideration to the issues of management and sustainable use. Most of the traditional and modern small-scale irrigation schemes managed by smallholder farmers are not well supported by expert knowledge and skills. Beneficiary participation, institutional support, input supply and marketing services are low and inadequate (Gebremedhin & Peden, 2002). Upstream developments and excess abstraction of water supplies negatively affect the welfare of downstream users (Hussain and Hanjira, 2004). Shortage of water for agriculture and other uses thus often push people into vicious competitions and disagreements over most of the smallholder irrigation schemes (Sultana, 2011; Belay & Bewket, 2013).

Smallholder irrigation has recently received significant focus from local governments in Ethiopia so as to enable farmers to cultivate crops at least twice a year (Makombe, et al., 2007). There are now few improved irrigation schemes sparsely distributed in the different parts of the country with the prime aim of ensuring household food security and improving the living standards of the community. The performances and challenges of smallholder irrigation schemes should be studied and provided with appropriate institutional support to improve their overall performance and capacity (Belay and Bewket, 2013). Different studies were conducted in the past (e.g. Ayaleneh, 2004; Asayehegn, et al, 2011; Bacha, et al., 2011; Kebede, 2011; Belay & Bewket, 2013), but most were not specifically focused on examining the challenges of irrigation water management in the smallholders' schemes. More research is thus required to fill the gap so as to enhance the performance of the smallholder traditional irrigation schemes.

In the study woreda (district), smallholder traditional irrigation has been practiced since early times. However, no detailed study related to the challenges of irrigation water management on smallholder schemes was conducted as is known to the authors, and hence, a knowledge gap to fill. This study intends to address the challenges of irrigation water management on the smallholder schemes in Dembecha woreda, in the north-western highlands of Ethiopia. It specifically aims to: assess the existing methods of irrigation water allocation practices in Dembecha woreda; identify the challenges faced by irrigators in managing irrigation water; and examine the conflict resolution mechanisms used by irrigation water users in the study woreda.

2. Description of the Study Area

Dembecha woreda is found in northwest Ethiopia, 350 kms northwest of Addis Ababa. It has an elevation ranging from 1,500-2,999 above mean sea levels (amsl). The total area of the woreda is 97,926 ha (DWoFED, 2015). Around 30% of the area is mountainous; 60% is plain; and 10% is a valley. Climatically, 11% of the woreda area falls under Dega (temperate) agro climatic zone; 83% is Woyna-Dega (sub-tropical); and 6% is Kola (tropical). The woreda has relatively enormous surface and ground water potential; comprising 28 streams and 180 springs. The most dominant soil types in the area are red (Nitosols) 65%; brown (Cambisols) 25%; and black (Vertisols) 10%.

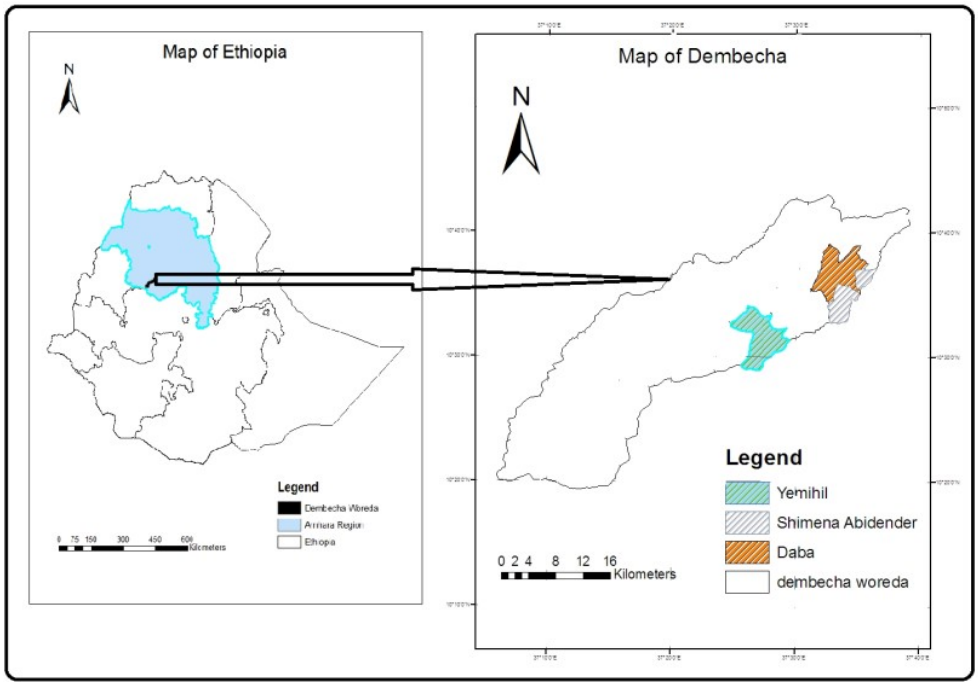

Figure 1 Map of the study area (Adopted from Ethio-GIS, 2007)

Based on projection from the Central Statistical Agency of Ethiopia (CSA, 2013), the woreda's population for July 2015 was 154,025. Among those 77,066 were men and 76,959 women. The total population of the urban residence was 28,062. Of those 14,382 were men and 13,680 women. On the other hand, the total population of the rural residence was 125,963 out of which 62,684 were men and the rest 63,279 women. About 85% of the woreda population was engaged in agriculture and 15% in other activities. The recently promoted traditional smallholder irrigation water management was not well documented or assessed by formal research study in Dembecha woreda. The lead researcher has purposely selected the site because of his prior knowledge of the area and the prevalence of irrigated agriculture.

3. Research Methodology

3.1. Sampling Techniques and Sample Size Determination

Three Rural *Kebele* Administrations (RKAs)[3]named Daba, Shimina-Abidender and Yemihil were selected purposefully for the study. The selection of RKAs was based on their irrigation potential and the number of streams and springs. Past and present irrigation experiences, accessibility, the lead researcher's prior knowledge of the area was also considered during selection of the sample RKAs. The total numbers of households in the three RKAs were 2,693. However, 2,486 total household irrigators were taken as a sample frame because the rest 207 households were not irrigators. From the irrigator households, 118 households were sampled for questionnaire survey.

The 118 households were systematically chosen from a stratified list of the total irrigator households categorized by the respective RKAs. To do this, the list of irrigation practicing households were first accessed from the registries of the offices of development agents (DAs) working in each RKAs and stratified by sex. Using this stratified list of irrigator households as sampling frame, 118 households (107 male- headed and 11 female-headed) were identified in a proportional to size sampling technique (Table 1).

Table 1 Sample households by RKA

	Total irrigator households by sex*		Sampled households	
Name of RKAs	Sex	N^0	№	%
Daba	Male	973	46	39
	Female	126	6	5
Shimina-Abidender	Male	568	27	23
	Female	28	1	1
Yemihil	Male	707	34	29
	Female	84	4	3
Total		2486	118	100

*Source: Development Agent (DA) offices at the study RKAs (February, 2015)

3.2. Data Sources and Determination Methods

The data used for this study were derived from both primary and secondary sources. The primary data included key informants' interviews (KII), structured questionnaires and observations of smallholder irrigation schemes and focus group discussions (FGDs). The KII

[3]Lower government administration unit of Ethiopia

were conducted to obtain general understanding on the smallholder irrigation water management practices of farmers; the water-sharing systems they employed; and the major water management problems encountered in the smallholder irrigation schemes. The samples included three DAs (one from each RKA); three water use committee members/WUC (one from each RKA); and three experts from the woreda agriculture office.

Both open and closed ended survey questionnaires were designed to generate household data. The designed questions focused on demographics, socio-economics, irrigation water-sharing, irrigation water management, irrigation challenges and conflicts. Prior administering the main survey, the questionnaires were pretested for fitness and certain amendments were made based on comments received from the preliminary survey Then, the revised questionnaires were translated into *Amharic* (the local language) to ease communication between respondents and enumerators. The data collections were done in February and March 2015 by the lead researcher assisted by trained enumerators. The lead researcher observed the daily activities of the irrigators in the study areas during the survey. This helped the lead researcher to conceptualize he reality of the irrigation water management and water-sharing challenges and conflict resolution methods of the irrigators in the area. Information gained in this way was used as triangulation to crosscheck the questionnaire survey data and to understand the ground reality regarding irrigation water-sharing and management practices. FGDs were conducted with open-ended questions in the entire three sample RKAs. A total of eighteen individuals participated in the FGDs, six from each RKA. From this number two of them were youngsters; two elders; and two female irrigators selected from each RKA. Moreover, secondary data from published and unpublished documents were compiled and used in the analysis.

3.3. Data Analysis Methods

Data were analyzed using descriptive statistics, T-test, Chi-square test, and qualitative narrations. The former methods were used to analyze the quantitative data. The latter (qualitative narration) was used to describe the qualitative data generated from KIIs, FGDs and field observations in an integrative manner.

Independent sample T-test was used to identify the existence of mean age and mean family size differences between farmers facing irrigation water shortages and those not facing irrigation water shortages. The Chi-square test was also used to detect the prevalence of any systematic association between nominal variables such as sex, education and different water

users. The Statistical Package of the Social Scientists (SPSS Version 20) was used in data preparation and management. Results were further illustrated using Tables and graphs.

4. Results and Discussion

This part of the result deals with the analysis and interpretation of data collected through questionnaires, KIIs, FGDs and field observations. Demographic characteristics of the respondents and challenges faced in irrigation water managements are also analyzed.

4.1. Characteristics of the Sample Respondents

The total sample households for the study were 118. Among those 91% were males and the rest 9% were females. Table 2 indicates that 75 households faced water shortages on their farms. Of these 87% were male-headed and 13% were headed by females. On the other hand, out of 43 respondents that did not face irrigation water shortages, 98% were headed by males and the rest 2% by females.

Table 2 Information on irrigation water shortage by sex of respondents

	Farmers facing water shortage		Farmers not-facing water shortage			
Sex	№	%	№	%	Total	Chi-square
Male	65	87	42	98	107	χ^2 =3.918
Female	10	13	1	2	11	P =0.048
Total	75	100	43	2	118	

Chi- square test was run to observe the existence of association between male-headed and female-headed households in facing water shortage on smallholder irrigation schemes. Accordingly, the result showed statistically significant systematic relationship between the two groups of households (χ^2 = 3.918, P = 0.048). This shows that water shortages systematically differ across the sex of the household heads in the study areas (Table 2).

Age can influence the production and productivity of irrigated crop and might create production difference among the irrigation areas. In Table 3, the age of the surveyed households is summarized and presented. Based on that, the majority of the irrigator households (56.8%) were adults (36-64 years of age). The others (37.3% and 5.9%) belong to above 64 years (old farmers) and 18-35 years (young farmers), respectively. This indicates that adult farmers had more access to participate in irrigation activities in the study areas.

Table 3 Age, irrigation experience and marital profile of the respondents

Household characteristics	Frequency	%
Age		
18-35 age (young farmers)	7	5.9
36-64 age (adult farmers)	67	56.8
Above 64 age (old farmers)	44	37.3
Irrigation experience		
Less than 15 years	40	33.9
15-20 years	37	31.4
>20 years	41	34.7
Marital status		
Currently coupled	87	73.7
Never married	3	2.5
Divorced	14	11.9
Widowed	14	11.9

Regarding work experience in irrigation (Table 3), the majority of the respondents (34.7%) have greater than 20 years of experience in irrigation work. The other 33.9% possess less than 15 years' experience, and the rest 31.4% have 15- 20 years of experience in irrigation work. With regard to marital status of the sample household irrigators, the majority (73.7%) were coupled, 2.5% never married, 11.9 % divorced and the other 11.9 % were widowed (Table 3).

Table 4 Mean age and family size differences between farmers facing and not-facing water shortage for irrigation

Variables	Farmers facing water shortage		Farmers not-facing water shortage		T-test results	
	Mean	St. dev	Mean	St. dev	T- value	P-value
Age in years	38.4	10.18	39.9	10.80	- .778	0.438
Family size	5.37	1.566	5.93	1.737	-1.786	0.077

Independent-sample T-test (Table 4) was run to study the existence of water shortage variation among the difference ages family size groups of farmers in the study areas. Consequently, the result showed that the mean age of farmers facing and not-facing irrigation water shortages were almost similar (38.4 years for the former and 39.9 years for the latter);

indicating a non-statistical difference (t=-.778, p= 0.438) between the two groups of farmers.Similarly, the mean family sizes of farmers facing and not-facing irrigation water shortages were 5.37 and 5.93, respectively. The independent-sample T- test result also showed a weak significant value (t= -1.786; p=0.077). This indicates also that there is no statistical mean family size difference between the farmers facing and not-facing water shortage.

4.2. Water-sharing and Management Practices in Dembecha Woreda

For irrigated agriculture water is a fundamental resource. Otherwise it is not possible to grow crops. Water allocation and distribution rules and practices are equally important for ensuring equity and sustainability among the farming community.

Table 5 Irrigation water sources

Irrigation water sources	Water users by sources	
	No.	%
Hand dug wells	2	1.7
Streams or rivers	68	57.6
Springs	47	39.8
Natural ponds	1	0.8
Total	118	100

The sources of irrigation water for the majority of the farmers (≈58 %) in the study areas are streams. Some 40% farmers get it from springs and the rest 2.5% from hand dug wells and natural ponds (Table 5). With regard to farm irrigation techniques used by irrigators in the study areas, 74.6% reported that they were using furrow irrigation. The other 25.4% indicated that they were practicing flood method of irrigation (Table 6).

Table 6 Methods of applying irrigation water into the farms in the study areas

Methods of irrigation	Users by RKA (in %) Shemina-Abidender (N=29)	Daba (N= 52)	Yemihil (N= 37)	Total (N=118)
Flood irrigation	41.4	28.8	8.1	25.4
Furrow irrigation	58.6	71.2	91.9	74.6
Total	100	100	100	100

Among RKAs, Yemihil is the largest user of furrow irrigation followed by Daba. Over 58 and 41% of the farmers in Shemina-Abidender reported that they use furrow and flooding methods, respectively. Only 28.8% and 8.1% of the farmers in Daba and Yemihil, respectively reported using flooding methods. Considering the above data, the proportion of farmers using furrow irrigation is high in Yemihil and low in Shimina-Abidender RKAs (Table 6). This result conforms to the studies of Dejen et al., (2006) reported for two small-scale irrigation systems in Western Oromia, Ethiopia. Misker (2012) in Sanka traditional and Golina modern irrigation schemes in Eastern Amhara, Belay and Bewket (2013) in Dangila woreda and Etissa et al. (2014) in the central rift valley of Ethiopia have also reported similar traditional methods of irrigation practices. All these researchers reported that irrigators in their study areas commonly used furrow irrigation.

Table 7 Irrigation water supply timing

	Respondents	
Time of irrigation	№	%
In the morning	26	22
At the mid-day	1	0.8
In the after-noon	18	15.3
At night	14	11.9
Whenever water is available	59	50
Total	118	100

Table7 presents the timing of irrigating farms by the households in the study areas. Accordingly, among the household irrigators, 50% of them stated that they irrigate their farm fields whenever water is available. The rest 22, 15 and 12% of them indicated that they use to irrigate their farms during morning, in the afternoon and at night times, respectively. According to KIIs, irrigation in the study areas is practiced from November to April. In the other months (from May to October), the farmers use rainwater to cultivate crops and no irrigation is used. Most farmers irrigate their fields whenever water is available taking turns in rotation and these farmers face a problem of water loss when they irrigate their farmlands and reduce the irrigation water, they are using due to mid-day evaporation as revealed by the key informants. This assessment indicated that there are urgent needs for training the farmers about suitable water management practices.

Table 8 Frequency of crop cultivation by applying irrigation water

Frequency of crop cultivation per annum using irrigation:	Farmers facing water shortages		Farmers not- facing water shortages		$\chi 2$ – value
	№	%	№	%	
Once	14	18.7	1	2.3	$\chi 2$=6.58
Twice	61	81.3	42	97.7	p=0.01
Total	75	100	43	100	

With regard to frequency of cultivation using irrigation, more than 81% of the farmers facing water shortage reported that they cultivate crops twice a year against to only 19% who produce only once a year (Table 8). From those farmers who are not-facing water shortages, 98 and 2%, respectively produce twice and once in a year. Chi-square test results ($\chi 2 = 6.577$, $p = 0.01$) showed a statistically significant relationship between farmers facing irrigation water shortages and those not-facing irrigation water shortages in frequency of irrigation. One can deduct from this that though there are problems related to irrigation water shortage, the majority of the farmers tackle the problems and produce crops twice a year. Therefore, if farmers get well managed irrigation water management potentials, they can even produce more than two times in a year.

According to KIIs, the main field crops grown using traditional smallholder irrigation in the studied schemes include: maize *(Zea mays)*, sugarcane *(Saccharum officinarum),* coffee *(Coffea arabica),* chat *(Catha edulis),* and vegetables such as potato *(Solanum tuberosum),* tomato *(Solanum lycopersicum),* cabbage (*Brassica oleracea*), carrot (*Daucus carota*) and green pepper *(Capsicum anuum).* Without irrigation, farmers cultivate teff (*Eragrostistef),* barley *(Hordeum vulgare)*, wheat (*Triticum vulgare*), maize (*Zea mays*), potato (*Solanum tuberosum*) and green pepper (*Capsicumanuum)* using rainfall. The first main cropping season is from June to November; during which households cultivate crops using rainfall. The second cropping season is from December to April. In this season, households cultivate crops only through irrigation.

Irrigation water in the study areas is distributed using rotation turns. Of the total respondent farmers, over 60% frequently use rotation turns to get irrigation water whilst some 38% of

them rarely use rotation turns to access water. Few farmers (< 2%) reported that they do not participate in rotation turns to get irrigation water (Figure 2). As learned from field observations, water-sharing works are facilitated by scheme level water use committees elected among the users. At household level, the head is responsible for coordinating the activities. The irrigation water distribution is planned according to the existing system layout and actual topographic conditions, so that irrigation water can be simultaneously delivered into each rotation block or group. That is why each irrigation site is divided into different groups. In practice, water distribution shifts are established based on counting dates, instead of water needs by plants.

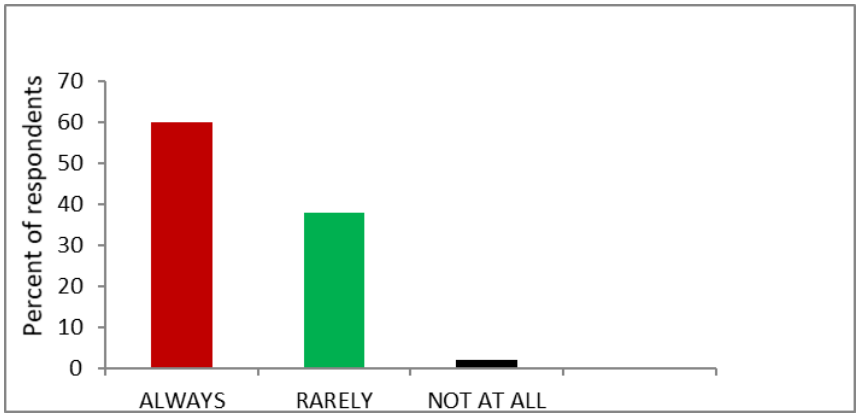

Figure 2 Frequency of usage of irrigation water turns

Intervals differ from season to season which depends on the amount of water in the study areas. The irrigation water rotation system practiced in the area is crucial for avoiding conflict among users and the peaceful coexistence of the community members. Hence, this practice should be assisted and supplemented by other stakeholders. Among 92 farmers who reported the existence of water user committees in their respective irrigation schemes (see Table 9), all indicated that the water use committees were headed more by men than by women. The use of water committees to manage water distribution is also reported in other different researches to have been operating in other similar areas of Ethiopia. For instance, Deribe (2008) in AtsbiWemberta and Ada'a, woredas; Belay and Bewket (2013) in Dangila woreda and Wotie and Hanaraj (2013) in South Achefer woreda, Ethiopia indicated that water distributions were managed by water committees. All these authors reported that irrigation waters were shared on rotation basis and the processes were managed by elected members of WUCs in their respective study areas.

Table 9 Irrigators' reports about water use committees

Question items	Response	№	%
Do you have WUCs in your RKA?	Yes	92	78
	No	26	22
	Total	118	100
If yes, do you have formal criteria to elect members of the WUC?	Yes	31	34
	No	61	66
	Total	92	100

As indicated in Table 9, out of the total 118 farmers interviewed, 78% reported the existence of WUCs in their irrigation schemes whilst 22% of them reported that no such committees were present in their respective schemes. As observed during field visits, the numbers of WUC members range from five to seven in Shimina-Abidender; were seven in Daba and Yemihil RKAs. In principle, the main function of the committees was distributing water among users, coordinating irrigation structural works and solving conflicts. During FGDs, participants expressed that WUCs were supported by DAs and the RKA police to enact governing rules and regulations in the irrigation schemes. The rules developed were documented in written forms and served to control irrigation operation and water management activities in the studied irrigation schemes.

Among 92 farmers who reported the existence of WUCs in their respective irrigation schemes, 61(66%) of them indicated the lack of formal rules (fixed criteria) to elect WUC members against the reports of 31(34%) respondents who remarked the presence of such formal rules (Table 9). In FGDs, participants noted that being model irrigator, honesty and having dignity in the community are considered as basic criteria to elect members of irrigation WUCs. These traditions conform to findings from other similar areas stating the absence of fixed formal criteria to elect WUC members beyond consideration of the individual's age, farming experience; honesty and acceptance in the community (e.g. see Belay & Bewket, 2013).

Table 10 Irrigators' responses about the performance of WUCs in resolving conflicts

Conflict resolving methods	Responses	№	%
Take immediate actions	Yes	33	36
	No	59	64
	Total	92	100
Suspend cases	Yes	64	70
	No	28	30
	Total	92	100
Use enforcing bylaws	Yes	25	27
	No	67	73
	Total	92	100

With respect to the performance of the WUCs in resolving water use conflicts, 36% of the 92 irrigators reported that they take immediate actions on cases appearing during water uses. But, 64% of them indicated that no immediate actions were taken by the committees when cases arise. About 70% of the respondents confirmed that the WUCs suspend cases to other days against the 30% who reported that the committees perform their duties with no postponement of cases to other times. Some 73% of the respondents remarked that the committees do not enforce internal bylaws established for conflict resolution purposes but 27% of them confirmed internal bylaws are enforced by the committees (Table 10). FGD results show that low level of efficiency, resistance by some WUC members and absence of external support cause reluctance among the committee members because participation in the irrigation management committee is not a full-time job. In addition, they have not been paid and compensated for the time they spent in irrigation management committee activities. Dejen et al. (2006) remarked that lack of support from the local stakeholders and inefficiency of the WUCs in enforcing rules and in resolving conflicts created frustration among irrigators.

4.3. Challenges of Irrigation Water Management

Smallholder irrigation has enormous potential to improve the income of poor rural households in developing countries like Ethiopia, but it is never free from problems. The major challenges encountered in the sector in the study areas are thus discussed in the following paragraphs.

The study on challenges of irrigation water management (e.g. Table 11) indicates that over 67% of the irrigators face water theft problems. Other many irrigators (>63%) also reported that they face rotation water turn abuses because of corruption and absence of effective

sanction to punish abusers. For instance, more than 64% of the irrigators noted the prevalence of poor water distribution and management. About 60.2, 35.6 and 33.1% farmers likewise remarked facing water abstraction by upstream irrigators, canal siltation and water loss through leakage and seepage, respectively. Similar challenges on irrigation water use and management were reported in other comparative RKAs of Ethiopia (e.g. see Belay & Bewket, 2013).

Table 11 Farmers' opinions on irrigation water management challenges

Types of challenges	Responses	№	%
Water loss through seepage/leakage from canals	Yes	39	33.05
	No	79	66.95
Canal siltation	Yes	42	35.59
	No	76	64.41
Poor water distribution coordination	Yes	76	64.41
	No	42	35.59
Water theft problems	Yes	80	67.80
	No	38	32.20
Water shortage at tail-end irrigation	Yes	55	46.61
	No	63	53.39
Upstream water abstraction by using motor pumps	Yes	71	60.17
	No	47	39.83
Sanctions not imposed against illegal water users	Yes	81	68.64
	No	37	33.36
Rotation turn abuses	Yes	75	63.36
	No	43	36.44

Note: Numbers in brackets are percentiles

Irrigators were asked to give information on water distribution between upstream and downstream users. Accordingly, over 55% of the respondents in the study areas indicated that the distribution of irrigation water between upstream and end-stream users is unfair. Around 89% of these respondents confirmed that upstream users get more water than downstream users. This situation is accompanied by inequality in water distribution, untimely water deliveries and insufficiency of irrigation water, with consequent losses of agricultural productivity and livelihoods for the poor. Information from KIIs also confirms that irrigators at tail-end locations receive the least share of water in the study RKAs. Irrigators at the head-streams (over 88% of them) are benefiting more than the tail-end irrigators. These farmers get the chance to access the first waters from upstream areas as a result of location advantages (Table 12). On the other hand, the KIIs revealed that those who live closer to the irrigation farms get more chance to better water access. Bacha et al. (2011) remarked that location significantly influences households' access to irrigation. Similarly, Asayehegn et al. (2011)

noted that farmers' residences in relation to water sources significantly affect their participation in irrigation practices. Belay and Bewket (2013) also reported that water accesses are controlled by factors of location in northwestern Ethiopia. For most farmers in the study areas, the shortage of irrigation water occurs from January to April and severe scarcity is encountered in April, similar to what is reported in Belay and Bewket (2013) in northwest Ethiopia.

Table 12 Farmers' responses on water distribution between upstream and downstream users

Question items	Responses	№	%
Is irrigation water distribution fair between upstream and downstream users?	Yes	53	44.9
	No	65	55.1
	Total	118	100
If no which of them do get more water?			
Upstream users		58	89
Middle stream users		6	9
downstream users		1	2
Total		65	100
Which social group gets more water?			
Farmers with large family size		1	0.8
Rich farmers		13	11
Head stream farmers		104	88.1
	Total	118	100

4.3.1 Measures ofStabilizing Water Shortage in the Study Areas

In the FGDs, respondents discussed about ways of stabilizing water shortage in the study areas. In the discussions, hand dug wells were identified as effective mechanisms of stabilizing temporary water constraints. The uses of motor pumps were also recommended by the farmers' groups as best technologies to deliver water from deeper wells, streams and rivers. Growing drought resistant and early maturing crops and early planting were also among the coping strategies mentioned by the farmers' groups.

Table 13 Availability of irrigation water package

Question	Responses	№	%
Is there irrigation package in your area?	Yes	50	42.4
	No	68	57.6
	Total	118	100

During the survey, participant farmers were asked whether irrigation packages were introduced or not to the area in the past. Accordingly, over 57% of them noted that they

didn't know any irrigation water management package (how much and when to irrigate) introduced in their respective RKAs. Conversely, 42.4% of the respondents indicated that they knew the existence of irrigation water management packages. Nevertheless, for farmers claiming that they have irrigation packages, their applications were not based on scientific knowledge. For most of them, irrigation package meant merely diversion of water to vegetable fields through furrows. This implies that smallholder irrigation crop production systems were not supported with latest technology and expert knowhow.

4.4. Water Conflicts and Mechanisms of their Settlement in the Study Areas

Conflict over the use of water is one of the main challenges of irrigation management in the study areas. During the field work, it was learned that there are competitions and conflicts for water among different irrigation water users. Competitions are growing common among motor pump users, modern river diversion water users and the users of traditional stream/spring diversions. This has caused some water-mills to stop operation and resulted in clashes between upstream and downstream water users.

Table 14 Farmers' responses for questions related to water conflicts

		Number of respondents	
Questions	Responses	№	%
Have you ever faced conflict over using irrigation water?	Yes	71	60
	No	47	40
	Total	118	100
If yes, what are the causes?			
	Water theft	5	7
	Increased number of users	29	41
	Water shortage	27	38
	Lack of proper control of water distribution	10	14
	Total	71	100

In the study RKAs, 60% of the farmers face conflicts related to irrigation water use. Several factors are attributed to the causes of the conflicts. Among 71 farmers who face water conflict, 41% relate the causes to increased number of users, 38% attach it to water shortage, 14% associate it with the lack of proper water management and 7% attach it to water theft (Table 14). In FGDs, crop damage due to free livestock grazing and crop theft are identified as major causes of conflict among irrigators in the study areas. Since crop thefts often happen at night times, it is very difficult to follow up and control the incidents. Moreover, there are conflicts between Shimena-Abidender and Daba RKAs over the use of water at River Korcha. Korcha river originates from Daba RKA and is also used as a source of irrigation water for Daba and Shimena-Abidender RKAs. FGDs revealed that water conflicts arising

between the two RKAs irrigators are settled by joint committees comprising selected elders and priests from the two RKAs. The committees used to meet once a month to negotiate cases.

Irrigators were asked about the methods they use to manage conflicts in their respective areas. Based on that, about 66 and 22% of the irrigators indicated that when they face problems in using water, they report to the WUCs and going to RKAs leaders, respectively. Other 5 and 7% irrigators indicated that they report to social courts and to police to resolve water conflicts (Table 15).

Table 15 Farmers' methods of water conflict management

Questions	Respondents by RKA (in %)			Total
	Shimina-Abidender	Daba	Yemihil	
How do you manage water conflicts?				
Reporting to WUCs	83	71	46	66
Going to RKA leaders	17	17	32	22
Reporting to social courts	-	-	16	5
Reporting to police	-	12	6	7
How do you evaluate the strength of water use committees?				
Strong	12.5	18	-	11
Medium	33.3	37	26.7	38
Weak	54.2	39	73.3	49
Very weak		5		2

Comparatively, 83 and 17% of the respondents in Shimina-Abidender RKA report the cases to the WUCs and to the RKA leaders, respectively. About 71 and 17% of the respondents in Daba RKA also report to the WUCs and to RKA leaders, respectively to settle conflicts. Some respondents (12 %) in Daba RKA take the cases to the police. In Yemihil RKA, 46 and 32% of the respondents report their cases to the WUCs and to the RKA leaders, respectively. Only in Yemihil RKA, 16% of the respondents report the cases to social courts. The proportion of reporting cases to the WUCs to settle conflicts in the study areas is less in Yemihil RKA as compared to Shimina-Abidender and Daba (Table 15).

Among 92 farmers who reported the presence of water use committees in the study areas (see Table 9), over 54 and 33% of them correspondingly explained that the functions of the WUCs were weak and medium in Shimina-Abidender RKA, respectively (Table 15). However, some 13% of the respondents rated that the functions of WUCs were strong. Over 39 and 37% of the respondents in Daba RKA indicated the functions of the WUCs were weak and medium,

respectively. Over 18% of them explicated that WUCs were strong. Moreover, in Yemihil RKA, over 73 and 26% of the respondents remarked that the functions of the WUCs were weak and medium, respectively. Though, the irrigators report their problems to the WUCs, the performance of the committees towards fulfilling the intended objectives with respect to managing the irrigation water is found to be low at all levels of the RKAs. The result of key informant interviews and FGDs also confirmed that resistance from some water users and lack of external support limit WUCs capacity and effectiveness.

4. Conclusions and Recommendation

The aim of this research was to assess the challenges of irrigation water management in smallholder schemes in the northwestern highlands of Ethiopia. It focused on three purposively identified RKAs namely Daba, Shimina-Abidender and Yemihil. Data were generated from a questionnaire survey of 118 irrigator households, KIIs and FGDs. The results showed that streams and springs played great role as irrigation water sources for the majority of the farmers. Over 60% of the irrigators in the study areas get water using rotation turns and over 74% of the farmers use furrows to access water to their farms.

Water-sharing works were facilitated by scheme level water committees elected among the users. At household level, the head was responsible for coordinating the activities. Therefore, smallholder irrigators elected their own irrigation WUCs in their respective study areas to facilitate irrigation water management practices and to solve conflicts which may arise related to the water usage. However, the performance of the WUCs towards fulfilling the intended objectives with respect to managing the irrigation water were found less satisfactory. WUCs were suspending different cases raised from irrigation users. They were unable to enforce internal bylaws that were enacted by the participation of the irrigation users and they failed to take immediate actions.

Generally, household survey results (i.e.63% respondents) revealed that shortage of water is the most important factor affecting irrigated agriculture in the study areas. Challenges which irrigators face during irrigation practices in the study areas were: water shortage, loss of water through seepage and evaporation, poor coordination of water distribution by WUCs, water theft problems and water shortages at the tail-end schemes, failure to control illegal water users, rotation turn abuses and water use conflicts. These all were important challenges faced by irrigators during their irrigation operations. It is suggested that government agencies should access expert guidance opportunities on irrigation water management to irrigation

users. Appropriate institutional support should be also provided to WUCs to allocate fair distribution of water and to settle conflicts through training and by offering professional support. Farmers should be encouraged to harvest rain and underground water to stabilize water shortages. Irrigation canals need to be constructed using concrete stone-mortars to avoid water loss through seepage.

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The Diversion of Abbay/ Nile[1] by Ethiopian Emperors: Claims and Disclaims

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Abstract: After Egypt occupied by the Arabs in 641, the relationship between Christian Ethiopia and Muslim Egypt was quarrelsome. Successive Muslim leaders of Egypt continue to convert Christians forcefully and this kind of maltreatment against Copts worsens the relationship between the two countries. In retaliation, Ethiopian Emperors took different measures against Muslim leaders. Sometimes they have invaded Upper Egypt and at another time diverted the course of Abbay so as to compel Egyptian Sultans with their request. Accordingly, Egyptians had been encountered a terrible famine because of the diversion of Abbay, to mention some, from 963 to 969, 1066 to 1072 and, 1199 to 1202. Regrettably, however, the ability of Ethiopian Emperors to divert the course of Abbay in order to stop the persecution of Copts considered as a myth. This paper attempted to examine medieval sources of Egypt and Ethiopia and offers substantial evidence as Abbay was diverted by Ethiopian Emperors.

Key words: Abbay, Copts, Diversion, Famine, Relationship;

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[4] In this paper I used the name Abbay instead of Nile because the name Nile is derived from the Geez Nil to mean blue in colour and parallel historically with the biblical Gihon from time immemorial up to nineteenth century. The Ethiopian great river has three names, Abbay (Abbawi), Geyon and Nil and these names signify the greatness of the river, its flow and colour respectively. See, Edward Ullendorff, *Ethiopia and the Bible*, (New York: Oxford University Press, 2006rpt), P.1 , Gerald O. West and Musa W. Dube (eds.), *The Bible in Africa: Transactions, Trajectories and Trends*,(Leiden, The Netherlands: Koninklik,NY, 2000), P. 143, Yared Shiferaw, Mätsehafä Säwasew Märeho Mätsaheffet(A Book of Grammar and a Guide to Books), (Bahr Dar: St. George Printing Press, 1997,E.C.), P.349, Taye Gebremariam, Mätsehafä Säwasew(A Book of Grammar), (Asmara: Il Poliographique P. L. C., 1938), P.100

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1. Introduction

In the relationship between the two countries two things can be considered as factors. This includes Christianity and Abbay. Christianity was one of the factors that united Egypt and Ethiopia and Abbay was another factor that played a predominant role in the relations between the two Countries. Abbay was instrumental for Ethiopian Emperors and whenever Copts persecuted by the Muslim rulers of Egypt, or when they failed to send annual tribute, several Ethiopian Emperors have sent threatening letters either to block the flow of Abbay or invade Egypt. Thus, Egyptians were under threat from Ethiopia for about a millennium and hence Abbay remained as a source of conflict, mistrust and fear between Ethiopia and Egypt and this is supported by medieval sources of both Ethiopia and Egypt. Unfortunately, recent writers dismissed these medieval sources as a myth.

1.1. Statement of the Problem

There are two narratives to be addressed in this paper. Medieval European travelers relate us that Ethiopian Emperors were powerful and able to divert the course of Abbay and this is in line with sources available both in Ethiopia and Egypt. On the contrary, later writers including the late professor Richard Pankhurst and some others flatly rejected these sources as a myth. Accordingly, almost all research papers, MA Theses and PhD dissertations produced on the Abbay Basin are in line with these writers. The main objective of this paper is to address this gap and show that:

The course of Abbay had been diverted at Khartoum and Upper Egypt was invaded several times by Ethiopian Emperors

The occurrence of famine in Egypt for seven or nine consecutive years was not associated with the drought in Ethiopia but by the diversion of Abbay.

2. Methodology

Method of data gathering and analysis is focused on literature review. Literature review includes both primary and secondary sources. I have consulted primary sources available at Institute of Ethiopian Studies and Ethiopian National Archives and Library Agency. Concerning secondary sources, I have examined both published and unpublished materials including research papers, MA Theses, PhD dissertations, books and internet sources exhaustively.

3. Results and Discussion

Results expected from this discussion: Besides the main finding, when the paper gets publication, it will inspire researchers to conduct their own researches as to whether Sudan was part of the Ethiopian empire or not. Besides, it will also serve as a source of information towards addressing similar issues.

River Abbay was a diplomatic weapon in the historic relations between Ethiopia and Egypt and even today it remains an overriding issue in the relationship between the two countries. The issue of Abbay, I think, will continue up until doomsday. This is due to the fact that while Ethiopia is the origin of more than 86 percent of the Nile waters, Egypt is dependent on it. Regarding the bounty of Egypt and where it emanates Penn states that 'The Nile is a text book example of an exotic stream, one that flows in a dry region and receives water somewhere else, in this case from the Blue Nile.'[2] Harris, the leader of British embassy to Ethiopia, gave similar expression. He states that 'Abyssinia holds in her Christian hands the inexhaustible riches of Egypt.'[3] The dependency of Egypt on the Abbay further elaborated by Moorehead as:

> The Blue Nile brings life down from the mountains to the desert and the delta. Without it the people of Egypt and of a great part of the Sudan could not exist for a single day. Even 'low Nile'- an annual flood that has been less than average is a disaster. This has always been so and is likely to continue forever.'[4]

As stated above clearly, due to exceptionally low flow of Abbay, Egypt had been affected by terrible famines repeatedly. Besides these recurrent famines, there were also repeated invasions made by Ethiopian Emperors against Egypt. The first invasion, after the latter occupied by the Arabs, recorded in the eighth century when Abba Michael I (743-767 A.D.) was Archbishop. At this time Egyptian Christians had faced a very great tribulation and as a result many of them fled from the land of Egypt and twenty-four thousand others denied Jesus Christ.[5] Besides, Abba Michael, was imprisoned by the last Umayyad Khalifa ,al-Wallid II, and when the Ethiopian Emperor heard the news of his imprisonment, he was filled with indignation and invaded Upper Egypt as far as al-Fustat and the caliph realized the invasion happened for the sake of the Abba Michael, then he released the patriarch from prison and implored him as follows:

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[2] James R. Penn, *Rivers of the World: A Social, Geographical and Environmental Source Book*, (Santa Barbara: ABC Clio, 2001), P.28.
[3] W. Cornwallis Harris, *Highlands of Ethiopia*, (New York: J. Winchester New World Press, 1843), P.137.
[4] Alan Moorehead*, The Blue Nile*, (New York: Harper &Row Publishers, Inc. 1962, PP. 18-19.
[5] E.A. Wallis Budge (trans*.), Synaxarium: The Book of the Saints of the Ethiopian Orthodox Tewahedo Church*, (Garland, USA: The Ethiopian Orthodox Tewahedo Debre Meheret St. Michael Church, ND), P.406.

> Then the king of Egypt entreated this father to write a letter to the king of Ethiopia, order him to return to his own country. And this father sent a letter to the king of Ethiopia wherein he invoked blessings upon him, and upon his governors and generals, and all his army, and he said unto him "Behold God hath delivered us from the bonds of captivity through thee. And now return to thy country in safety and peace, and God reward thee in the kingdom of heaven for the toil which thou hast undertaken for me." When the king of Ethiopia had read the letter sent to him by this father Archbishop Abba Michael, he rose up quickly and returned to his country in peace.[6]

This invasion was retaliation for the persecution of Copts.

In 963 (A.H. 352), as recorded by Muslim Historians, Egypt was afflicted with a terrible famine and it lasted for seven years, or as some say for nine years. And as a result, about 600,000 Egyptians perished by this famine in Fustat and neighbouring towns of Babylon and Misr alone.[7] Bianquis relates us that Egypt had never experienced this kind of famine caused by a series of low Nile floods from 963 to 969.[8] In 971 (A.H.361) after a long period of starvation, Abbay rose to its full height and this happened because the new dynasty relieved the Christians from taxes, enforced public order and safety.[9] As stated above, it appears that the famine began in 963 caused by the diversion of Abbay. Because, in 956 and in 967 Egypt was invaded by Ethiopians, albeit some sources called Nubians.[10] The contemporary Ethiopian Emperor, Janseum (965-1005), who considered himself as the guardian of Copts, remembered by his menacing letter against the Fatimid caliph. The reason why he sent an ultimatum was that an Egyptian bishop, who was nominated as the metropolitan of Ethiopia, had been promised to the Fatimid caliph to pursue a pro-Muslim policy in Ethiopia. And when he attempted to implement his promise in building mosques secretly, the mosques demolished and the bishop jailed. In reprisal, the Fatimid caliph sent a threatening letter to destroy the churches of Egypt, if Janseum failed to rebuild mosques and in return, the Ethiopian Emperor replied that, if any church in Egypt to be destroyed, he would himself dismantle the Ka'aba in Mecca.[11] The cause of famine from 963 to 969 indicates as Abbay was diverted by Janseum's predecessor.

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[6] Budge, *Synaxarium*, P.407

[7] E. L. Butcher, *The Story of the Church of Egypt, Being an Outline of the History of the Egyptians Under their Successive Masters from the Roman Conquest Until Now*, (London: Smith, Elder & Co., Vol. I, 1897), P.497

[8] Thierry Bianquis, "*Autonomous Egypt from Ibn Tulun to Kafur, 868-969*", in Carl F. Petry (ed.), The Cambridge History of Egypt: Islamic Egypt, 640-1517, (Cambridge: Cambridge University Press, Vol. I, 2008), P.117

[9] Butcher, Vol. II, P.8

[10] Ibid.Vol. I, PP.496-497.

[11] Abba Gorgoryos, *Ya Ityopia Orthodof Tawahedo Beta krestian Tarik (A History of the Ethiopian Orthodox Tawahedo Church)*, (Addis Ababa: Tensae Zagubae Printing Press,1993,4th ed.), P.32

There was another terrible famine in Egypt, which lasted for seven years (1066-1072). Regarding this famine, Lane-Poole relates us that "Cairo and Fustat were cut off from supplies, and a terrible famine which had begun with the low Nile of 1065, and lasted unbroken for seven years (1066-1072), brought the country to the utmost pitch of misery."[12] This disastrous famine destroyed two-thirds of Cairo.[13] This famine was called al-shidda (the calamity) by medieval chroniclers.[14] A thirteenth century writer, Imam al-Dahabi, compared this famine with that of Joseph's time. Al-Dahabi states that during the reign of al-Mustansir there was a famine in Egypt, the like of which had never seen since the time of Joseph and that famine continued for seven years so that multitudes devoured each other.[15] Similarly, the harshness of the famine that devastated Egypt in the eleventh century described as:

> In Cairo, Fostat, and Babylon, a loaf of bread was sold for fifteen dinars, one egg for a dinar, a cat for three dinars, a dog for five. Even the supply of dogs and cats ran short, and one man was convicted of driving a regular trade in human flesh. He decoyed women and children (no doubt with offers of food), strangled them, and exposed the flesh for sale. All the immense establishment of horses, mules and camels belonging to the Kaliph had been eaten, except three horses; the ornaments of the tombs of his ancestors and the wardrobes of his women had been sold for bread.[16]

Anyone who examines the causes of recurrent famines in Egypt, it is certain that they were all directly associated what was happened in Ethiopia-either by a severe drought or else by the diversion of Abbay. A famine caused by the failure of the flow of Abbay and which is recorded in one of Egyptian inscriptions described as:

> For seven years the Nile has not risen. There is no grain, the fields are dry, no man buries his neighbour, everyone flees, to return no more, the children weep, the young men faint, the old men wither. Their legs have lost their strength; with folded arms they crouch on the ground.[17]

It is evident that the cause of famine in Egypt cannot be a failure of local rainfall because Egypt is dependent on the annual flood of Abbay. Thus, the low flow of Abbay was caused either by the diversion of Abbay or by a severe drought in Ethiopia. It is apparent that the volume of Abbay will be reduced by drought and it is also true that drought appears within

[12] Stanley Lane-Poole, *A History of Egypt in the Middle Ages*, (New York: Charles Scribner's Son, Vol. VI, 1901), P. 146.
[13] Wladyslaw B. Kubiak, *Al-Fustat: Its Foundation and Early Urban Development*, (Cairo: The American University in Cairo Press, 1987), P.12
[14] Paula A. Sanders, "*The Fatimid State, 969-1171*," in Carl F. Petry(ed.), The Cambridge History of Egypt: Islamic Egypt, 640-1517, (Cambridge: Cambridge University Press, Vol. I, 2008), P.152
[15] H.S. Jarrett (trans.), *History of the Caliphs*, (Calcutta: J. W. Thomas Baptist Mission Press, 1881), P. 439
[16] Butcher, Vol.II, P.51
[17] Mary Lindsay(trans.) The Nile: The Life-Story of a River, (London: George Allen & Unwin Ltd,1960) P.439

certain part of Ethiopia occasionally but there no historical evidence as Egypt afflicted by famine due to the prevalence of drought in Ethiopia. For instance, in 1913, before dams constructed and in 1984 Ethiopia had been encountered a severe drought and hence the annual discharge of Abbay reduced from its highest level 150 billion cubic metres of water to its lowest 42 billion cubic metres but famine was not recorded in Egypt.[18] The lowest flow of Abbay in 1913 affected only the cotton crop of Egypt.[19] As stated above, all the famines recorded in Egypt were associated with the low flow of Abbay and if the lowest flow of Abbay in 1913 does not affect any food crop in Egypt, so any severe drought happened in Ethiopia cannot be a cause of famine in Egypt.

The cause of famine in Egypt in the period 1066-1072, for example, caused by the low flow of Abbay and when one examines whether it caused by the diversion of Abbay, or not, there are ample sources that signify as Abbay was diverted into the Red Sea. The news for the diversion of Abbay was widely disseminated and this stated aptly by Donzel as 'For at least 600 years, perhaps even a millennium, Arab, Ethiopia and European sources mention that the Ethiopians were able to or thought to be able, to block off the Blue Nile, or divert its course, so as to starve Egypt and bring Islam to its knees.'[20] It is evident that Abbay has been diverted by an Ethiopian Emperor in the eleventh century and this confirmed by the subsequent Coptic writer, Jiris al-Makin. Al-Makin reports that the course of Abbay had been turned by Ethiopians and later the flow of the river restored to its old bed through mediation.[21] The mediation made by Abba Mikhail IV to restore the flow of Abbay reported as:

> It then happened that one year the Nile inundation was low. The caliph al-Musta 'li, who had succeeded al-Mustansir- knowing that the sources of the eternal river lay in Ethiopia, requested Abba Mikhail IV to go there, meet the king, present him with sumptuous gifts, and entreat him to find the means by which the Nile waters could readily reach the desired amount. Abba Mikhail was only too glad to perform this service. He was welcomed in Ethiopia with joy. The king ordered his men to remove all the impediments in the course of the river. This led to a rise of over five feet during one night. St. Mark's successor spent some time in Ethiopia, and consolidated the bonds of

[18] Terje Oestigaard, *Water Scarcity and Food Security along the Nile: Politics, Population Increase and Climate Change*, (Uppsala: Nordiska Africainstitutet, 2012), P.48
[19] Lindsay(trans.), *The Nile*, P.376
[20] Emery Van Donzel, *'The Legend of the Blue Nile in Europe*, in Haggai Erlich &Israel Gershoni(eds.), The Nile: Histories, Cultures, Myths, (Boulder &London: Lynne Rienner Publishers, Inc.,2000), P.121
[21] E.A. Wallis Budge, *A History of Ethiopia, Nubia and Abyssinia*, (Oosterhout N.B.-The Netherlands: Anthropological Publications, Vol., 1970), P.279

> friendship between the caliph of Egypt and the king of Ethiopia, which both greatly appreciated.[22]

Similarly, Makrizi, a well-known Egyptian writer (1364-1442), relates that the seven years famine in Egypt was resolved with the intervention of the patriarch, who had been sent to Ethiopia. However, Makrizi failed to tells us what looks like the mediation between the patriarch and the Ethiopian Emperor. He merely states that 'Then the king ordered a certain enclosed valley whence the Nile flows in to Egypt to be opened. No sooner was this done than the Nile rose three yards in one night, and went on rising until it overflowed the country and the crops.'[23] As stated above plainly, there is no valid reason to doubt that in the eleventh century Abbay was diverted and the motive behind Ethiopian Emperor to divert the course of Abbay against Egypt seems retaliation to the persecution of Christians. During the reign of al-Mustansir, Egyptian Christians suffered a lot. For instance, in 1057 - al-Yazuri, Wazir of al-Mustansir, closed churches, imprisoned the patriarch and tortured three bishops to death.[24] According to Abba Gorgoryos, the diversion of Abbay in to the Red Sea was made by Emperor Yimrihane-Kristos(1084-1093), an Ethiopian Emperor from Zagwe Dynasty, but the period he claimed do no match with the period of 1066-1072 .[25]

During the reign of Lalibela (1167-1207), Egypt again devastated by a severe famine from 1180-1182 and from 1199-1201.The famine that started in 1180 resolved in 1182 when Salah al-Din, the famous Egyptian ruler, came to power. While Salah al-Din was in power, it seems that the situation for Copt Christians was safe. In 1189 Salah al-Din restored a number of churches to Ethiopian monks in Jerusalem.[26] After he died in 1193, his successor began to persecute Egyptian Christians. As a result, multitudes immigrated in to Ethiopia and other parts of the world. Concerning the migration of Egyptian Christians, Malaty states that with the permission of the Nubian king, Lalibela accepted 10,000 Copts to refuge them in present day Sudan.[27] To revenge the persecution of Copts, Ethiopians, albeit some sources erroneously called Nubians, led by Lalibela invaded Upper Egypt and diverted Abbay. In

[22] El Masri, P.137. The period 1066-1072 falls under the fifth Fatimid caliph of Egypt, al-Mustansir (1036-1094) and during this time Abba Mikhail IV was not patriarch of Egypt, but a local bishop. It was from 1092-1102 that Abba Mikhail became patriarch of Copt Christians.
[23] Butcher, Vol. II, P. 73
[24] Mark N. Swanson, The Coptic Papacy in Islamic Egypt (641-1517), (Cairo: The American University in Cairo Press, 2010), P.62
[25] Abba Gorgoryos, P.35
[26] Taddesse, "*Ethiopia*, *The Red Sea, and the Horn*" in Roland Oliver (ed.), The Cambridge History of Africa, From c.1050 to c.1600, (Cambridge: Cambridge University Press, Vol. 3, 2008), P.114
[27] Tadros Y. Malaty, *Introduction to the Coptic Orthodox Church*, (Alexandria: St. George's Coptic Orthodox Church,1993), P.154

consequence, the flow of Abbay became very low and the canals built for irrigation completely dried for about three years, 596-598 A. H. (1199-12001 A. D.).The famine from 595-598/1199-1202, as Chamberlain claims, described as the second worst since the conquest of Egypt by Fatimid dynasty.[28] The retaliation of Emperor Lalibela was unbearable for Egyptians and this depicted by the contemporary writer, Abd el-Latif, as:

> The wretched people abandoned their desolate fields and crowded in to the towns along the river; there was no reserve of money or food to fall back upon, and the poorer classes almost from the beginning had to subsist on the flesh of dogs, of horses, of those men and women who had died before them of starvation. Some of them went still further and devoured their own children in their extremity; some set up a regular trade in human flesh, decoying women and children with offers of food, murdering them, and exposing the flesh as meat for sale.[29]

Regarding this diversion, Taye states that Lalibela dug a canal at Khartoum in order to deflect the flow of Abbay in to the Sahara.[30] Similarly, Tekle-Iyesus elaborated the campaign and its effect as "**፬ ጊዜ በዘመኑ የአማራን ጦር ሰብስቦ ወደ ምስር እስላም ዘመተ፤እስላሞቹም ሸሹ። ደግሞ የምስር ሰዎች ያለ ዓባይ ውሃ የላቸውም ሲል ዓባይን በሌላ ሥፍራ መግደል ቆፍሮ በስናር በረሃ ሰደደው። ከዚህ በኋላ የምስር ሰዎች ሲቸግራቸው ጊዜ ግብር አመጡለት።**"[31]

(Having gathered Amhara fighters, once upon a time Lalibela has made a campaign against Muslim Egyptians, then the Muslims retreated. Again, when he realized that Egyptians have no water without Abbay, Lalibela diverted Abbay into the Sennar desert and here after the people of Egypt suffered (with lack of water) and hence they brought a tribute to him.)

Some European travellers claimed that the source area of Abbay was not under the control of Emperor Lalibela but their claim is groundless. The hagiographer of Emperor Näakuto lä Ab (1207-1247), successor of Lalibela, confirms that Abbay was diverted by Lalibela for three years and three months. The scribe states as "**ወአቀሞ ለማየ ተከዚ ፫ ዓመተ ወ፫ አውራኃ በኃይለ ጸሎቱ ወኃጥኡ ማየ ዘይሰትዩ።**"[32]

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[28] Michael Chamberlain, *"Crusader Era and the Ayyubid Dynasty*," in Carl F. Petry (ed.), The Cambridge History of Egypt: Islamic Egypt, 640-1517, (Cambridge: Cambridge University Press, Vol. I, 2008), P.221.
[29] Butcher, Vol. II, PP. 117-118
[30] Taye Gebre-Mariam, *Ya Ityopia Hezeb Tarik (A History of the People of Ethiopia*), (Addis Ababa: Central Printing Press, 1964), P.50.
[31] Sergew Gelaw (ed.), *Ya Ityopia Tarik (A History of Ethiopia)*, (Addis Ababa: Berhanena Selam Printing Press, 2002 E.C.), P.26.
[32] Gädelä Näakuto läAb (A Hagiography of Emperor Näakuto läAb), Institute of Ethiopian Studies, MS. 55. P.73.

(By the power of his (Lalibela) prayer the emperor had stopped the flow of Tekeze for three years and three months and they (Egyptians) suffered with lack of drinking water).

Here the scribe seems ignorant as Tekeze is tributary of Abbay. On other hand, the effect of diversion reported as "**ወይቤሉ· እሙንቱ· ሰብአ ግብጻዊያን ቀዲሙ· ነበርነ በኢያእምሮትነ ከሊአነ አምኃ መንግስትከ ዮምኒ አምጻእነ አምኃ መንግስትከ ከመ አእመርነ ኃይለ ጸሎትከ ወቀሰፈነ ረኀብ ወምንዳቤ፡**"[33]

(The Egyptians said that due to our ignorance we have been reluctant to bring your tribute but today we have brought because we understood that your prayer has made us suffered with starvation).

There is no doubt that Abbay was diverted by Emperor Lalibela and traces of these diversion discovered by the British explorer, Charles Beke.[34]

The use of Abbay as a bargaining chip continued in the medieval period. In 1321, anti-Christian riot led the destruction of sixty churches in Egypt and so many Copts converted into Islam.[35] In the year 1325, when the violence of the persecution of Copts had abated, Emperor Amdatseyon (1314-1344), sent emissaries with a threatening letter to Cairo. The content of the letter stated as 'Nasr received a letter from the Emperor of Abyssinia, commanding him to rebuild the churches which he had thrown down by the Moslems, and to treat the Christians better, or he would thrown down every mosque in the kingdom of Abyssinia and intercept the course of Nile.'[36] Concerning the mighty and prosperity of the Ethiopian Emperor, Jordanus, a contemporary of Amdatseyon and who was in northern Ethiopia reported as:

> The lord of that land I believe to be more potent than any man in the world, and richer in gold and silver and in precious stones. He is said to have under him fifty-two kings, rich and potent. He ruleth over all his neighbours towards the south and the west.... To that emperor the Soldan of Babylon giveth every year 500,000 ducats of tribute as 'tis said.[37]

[33] Ibid. P. 74.
[34] Charles F. Rey, *Unconquered Abyssinia: As It Is To-day*, (London: Seeley, Service & Co. Ltd, 1923), P.89
[35] Swanson, P. 102.
[36] Butcher, Vol. II, P.201
[37] Henry Yule(trans.), *The Wonders of the East*, (London: Hakluyt Society, 1863), P.46

Similarly, Kaula states that 'The king would block the river's flow if the persecutions were not stopped. Moreover, he demanded tribute, and this the Egyptians paid regularly until about 1400.'[38] Nasr, the Egyptian Sultan, complied for the demand of Amdatseyon favourably. Regarding this, Erlich tells us that "Al-Nasir Muhammad ordered the Coptic Patriarch to send a letter of appeasement to Amdatsyon. 'The Ethiopians claim they were the guardians of the Nile', wrote the contemporary Egyptian historian Fadlallah ibn al-Umari."[39] This external intervention by Amdatseyon on behalf of Copts was quite efficacious. His intervention appreciated as:

> His [Amdatseyon] threatening power was strong because he menaced on the one hand to deflect the course of the Nile, and on the other to retaliate against Abyssinian Muslims. By posing these threats, he was able to come to terms with Egypt's Sultan to relieve the Copts to some degree of the pressures and hardships they had been suffering.[40]

The tension between the Muslim Egypt and Christian Ethiopia continued during the reign of Sayfa Ar'ed also known as Newayä Krestos and Constantine (1344-1372). During the reign of Sayfa Ar'ed many Copts forced to embrace Islam and churches pulled down and mosques built instead. For instance, in Kalioub, an Egyptian town in Upper Egypt, more than four hundred and fifty Christians became Muslims in a single day.[41] Furthermore, the Sultan dismissed all the Copts from government offices and above all Abba Mark IV (1348-1363), patriarch of the Copts, thrown into prison and treated cruelly. According to Butcher and el-Masri, Abba Mark released from prison with the involvement of a Nubian king by seizing all the Muslim merchants in his own territory as hostages until the sultan complied with his request.[42] On the other hand, the Ethiopian Synaxarium relates us the cause of Abba Mark's imprisonment differently as:

> And the king of Mesr (Cairo), a Hanafite, forced him [Abba Mark] to send an embassy to the king of Ethiopia, who was in submission to him, concerning the Muslims who dwelt under his rule. Now there was in his days a king, whose name was Sayfa Ar'ed, and he was also named Constantine, and he slew many of the Muslims who rebelled against him, and some of them he drove out of his country and they went to the king of Mesr (Cairo) and took refuge with him. And they said, "The king of Ethiopia hath made an end of the Muslims; some of them he hath slain, and some of them he hath made Christians." When the king of Mesr (Cairo) heard

[38] Edna Mason Kaula, *The Land and People of Ethiopia,* (New York: J. B. Lippincott Company, 1972), P.125
[39] Haggai Erlich*, The Cross and the River: Ethiopia, Egypt and the Nile,* (Boulder& London: Lynne Rienner Publishers, Inc., 2002), P.43.
[40] El-Masri, Book III, P.190.
[41] Butcher, Vol. II, P.211.
[42] Ibid., El-Masri, Book III, P.188.

> these words, his zeal for his religion rose up, and he compelled the archbishop to dispatch elders to [Ethiopia], and he told him that he held him as hostage for the obedience of the king of Ethiopia and the safety of other Muslims who were in his kingdom.[43]

As a result Abba Mark sent two honourable bishops, Abba John and Abba Cyril, to Ethiopia and Sayfa Ar'ed received them with a great honour but he never allowed returning back to their homeland.[44] However, there is no an indicative whether Emperor Sayfa Ar'ed complied with the request of Abba Mark and released from prison in consequence. In 1363, patriarch Mark died and in the following year Egypt hit by a terrible famine but due to scanty of sources, it is impossible to ascertain it whether this famine was a revenge of Sayfa Ar'ed or not.[45]

During the reign of Newayä Maryam, also known as Wedem Asfaré or Germa Asfaré (1372-1382) there was a famine in Egypt in 1373 owing to the low Nile, and the usual liturgical processions held by both Christians and Muslims to cry loud for water. In this prayer, Makrizi took part while he was nine years old.[46] This famine led to discontent and next a revolution among the Mamlukes and hence the regent deposed, then killed by his own guard.[47] As stated above, the cause of this famine in Egypt seems man made, but due to scanty of sources, it is difficult to confirm it. In 1380, Makrizi reports that forty-nine Copts murdered and some of these martyrs remembered in Copto-Arabic Synaxarium.[48] This kind of massacre intensified the enmity between Germa Asfaé's successor, Dawit (1382-1411) and his contemporary Egyptian leader, Barquq (1382-1399). In retaliation for the maltreatment of Copts, Dawit invaded Upper Egypt. The scribe of his chronicle reports as:

ወኮነ ሠራዊቱ እለ ወረዱ ምስሌሁ ብሔረ ግብጽ! ፫፻ አፈራሰ ወ፲ ፫፻ አብቅልተ ወ፲፫፻አግማለ ወሶበ በጽሐ ጎበ ክርቱም ወወጠነ ከመ ይሚጦ ለፈለገ አባይ ጎበ ክርቱም ከመ ይክልኦሙ ለሰብአ ግብጽ ማየ ፈለገ ዓባይ ዘይሰመይ ግዮን፡...ወሶበ ሰምዐ ንጉሠ ኢትዮጵያ ዳግማዊ ዳዊት ምጽአቶ ለሊቀጳጳሳት አባ ሚካኤል ወወረደ ምስለ ጎዳጣን ሠራዊቱ እስከ ምድረ አስዋን ዘውዕቱ ወሰን ማዕከለ ኢትዮጵያ ወግብጽ ::[49]

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[43] Budge (trans.), *Synaxarium*, P.102.
[44] Ibid.
[45] Butcher, Vol. II, P. 212.
[46] Ibid. P.213.
[47] Ibid.
[48] Swanson, PP.115-116.
[49] *Yä Atse Dawit Tarik* (A History of Emperor Dawit), Ethiopian National Archives and Library Agency, **ብቤመ-507፣** PP.54-55

(The number of troops descended to Egypt (with Dawit) were some hundred thousand on the horse back, hundred thousand others on the mule, and hundred thousand on the camel. And when he arrived at Krtum, he began to divert River Abbay to the Krtum(canal) in order to prevent the people of Egypt from the water of Abbay called Geyon.... When Dawit II, king of Ethiopia, heard the coming of Abba Michael, a patriarch, he descended with some of his troops to the land of Aswan, which is a border between Ethiopia and Egypt).

The invasion made by Dawit against Egypt is beyond the shadow of doubt because it also accepted by Egyptian writers. Regarding Dawit's invasion, El-Masri reports as 'For when the Nubian [Ethiopian] king raided Aswan, Barquq did not war against him, but asked Abba Matheos to write him a letter of conciliation.'[50] Similarly, Malaty, another Egyptian writer, tells us that 'When David, the king of Ethiopia raided Aswan, the pope sent him a bishop with a message, accompanied by a delegate from the sultan, the king responded favourably and returned to his country.'[51] Moreover, Makrizi, the contemporary writer, reports that, as cited by Taddesse, Dawit 'had invaded the territory of Aswan, defeated the Arabs and ravaged the lands of Islam.'[52] These Egyptian sources, however, are silent about the diversion of Abbay by Emperor Dawit. The reason why Dawit diverted the course of Abbay stated as **'ወውዕቱ ዳዊት ዘሜጦ ለፈለገ አባዊ ከመ ኢይረድ ግብፅ በምክንያት ዘሞቅኖ ንጉሠ ግብፅ ለአባ ዮሐንስ ሊቀ ጳጳሳት ዘለእስክንድርያ በምክንያተ ፀባህት ወበይነዝ ፈነዎ ሎቱ ንጉሠ ግብፅ አምሃ ለዳዊት ንጉሥ ግማደ መስቀሉ ለክርስቶስ።።**[53]

(At that time Dawit has diverted River Abbawi, not to flow to Egypt because the Egyptian Sultan jailed Abba Yohannes, patriarch of Alexandria, due to their quarrels and hence the Egyptian Sultan sent a gift to king Dawit a piece of the True Cross of Christ).

Ethiopian writers, unlike Egyptians, focus on the diversion of Abbay. Tekle-Iyesus, for example, asserts that when Emperor Dawit had realized that all the Christians of Egypt would be embraced Islam forcefully, he went to Khartoum and diverted the course of Abbay into the Sennar desert and the Muslims of Egypt forced to reconcile with him.[54]. It appears that Dawit initially had invaded Upper Egypt and after some years he diverted the course of Abbay.

[50] El-Masri, Book III, P.198.
[51] Malaty, P. 171.
[52] Taddesse Tamrat, "*The Horn of Africa: The Solomonids in Ethiopia and the States of the Horn of Africa*," in D.T. Niane(ed.), Africa from the Twelfth to the Sixteenth Century, (California: University of California Press, 1984), PP.450-451.
[53] Tekletsadik Makuria*, YäGragn Ahmad Wärära (An Invasion of Ahmad Gragn*), (Addis Ababa: Berhanena Selam Printing Press, 1966), P.90, During the reign of Dawit, the Patriarchs of Alexandria were Abba Mathewos I(1375-1409),and Abba Gabriel V(1409-1427).
[54] Sergew(ed*.),* P.34.

Regarding this, Erlich states that 'Dawit began his rule in 1381 by raiding Upper Egypt and inflicting heavy blows on the Muslims.'[55] At this time famine was not recorded in Egypt. It was in 1403 that Egypt afflicted by a terrible famine as recorded by Makrizi and he relates us that during this famine one of his daughters was ill, and bought two chickens for her with seventy-four pieces of silver.[56] In 1400, following the death of Barquq, patriarch Matheos was imprisoned by the successor of Barquq.[57] As stated above, the justification behind the diversion of Abbay by Dawit was associated with the imprisonment of the patriarch, though the name of the patriarch wrongly called Abba Yohannes instead of Matheos. The invasion and victory of Dawit against Egypt seemed familiar for European kings and I think, this was the motive behind Henry IV of England to send a letter to Emperor Dawit in 1400, with an intention of forming a crusade alliance against Muslims.[58] Some writers, however, consider that the diversion of Abbay by Dawit as a fiction. For instance, Veronika Six dares to criticize the claim of Ethiopian scribes as 'Ethiopian imagination therefore takes for granted that fiction may turn in to reality, because it is established in the Ta'amrä Maryam.'[59] This is an abrupt and misleading conclusion because it was usual for Ethiopian chroniclers to associate any achievement or victory of an emperor either with the help of God or with the prayer of saints but this does not necessarily mean that the achievement or victory of that emperor was false. To mention one example, the victory of Adwa was associated with the help of St. George.

Emperor Yeshaq (1414-1429), followed the policy of Dawit. He began his reign by invading the rebel Muslims of Ifat and subdued Zeila in 1415.[60] In 1427, Yeshaq dispatched delegates to Valencia and Aragon for the purpose of establishing friendly relations with European Christians. In response to his request, Alfonso, king of Aragon, proposed a double marriage union between his kingdom and Ethiopia.[61] In 1429, a secret treaty was signed between Emperor Yeshaq of Ethiopia and the 'Franks' to engage in a holy war against Muslims of the world. The agent of this treaty and ambassador between Ethiopia and Europe was a Christian merchant disguised himself as a Muslim. This merchant carried out his negotiations with the

[55] Erich, P.43.
[56] Butcher, Vol. II, P. 221.
[57] Swanson, P. 114.
[58] Andrew Kurt, "*The Search for Prester John, a Projected Crusade and the eroding Prestige of Ethiopian Kings, c.1200-c.1540,*" in Journal of Medieval History, (Vol. 39, No. 3, 2013), P.309.
[59] Veronika Six, *"Water, The Nile and the Ta'amrä Maryam: Miracles of the Virgin Mary in the Ethiopian Version,*" in Aethiopica, International Journal of Ethiopian and Eritrean Studies, (Hamburg: Hamburg University, Vol. II, 1999), P.59.
[60] Erlich, P.44.
[61] Matteo Salvadore, "*The Ethiopian Age of Exploration: Prester John's Discovery of Europe, 1308-1458*," in Journal of World History (Vol. 21, No. 4, 2011), P.611.

Franks successfully but while he was returning to Alexandria, he was betrayed by his own slave and the plot against Egypt disclosed, so that the kadis tried him and sentenced to death with two other Ethiopian monks. [62]

Emperor Zara Yaeqob (1434-1468), who was one of the greatest monarchs in Ethiopia's history, considered himself as the protector of Orthodox Christians of Egypt. In 1437, he sent delegates to sultan and requested the good treatment of Copts and their churches.[63] In 1443, Zara Yaeqob received a letter from Abba Yohannes XI (1427-1453) about the destruction of Dayr al-Maghtis or Menas, a monastery which had been a way station for Ethiopian pilgrims to Jerusalem. Zara Yaeqob angered and sent a delegation with a threatening letter to Jaqmaq. In Nov. 1443 a delegation from Zara Yaeqob handed this letter to Sultan Jaqmaq.

> From the righteous ... Zar'a Yaeqob ... king of kings of Ethiopia... to the noble, elevated Imam, the royal sultan al-Zahir Jaqmaq, sultan of the Muslims and of Islam in Egypt and Syria. It is our goal to renew the understandings that existed between our predecessors. Let these understandings remain preserved without interruption. You, may the good Lord save you, know well what the shepherd needs to do with his sheep. Our father the patriarch and our brothers the Christians, who are under your government and under your noble kingdom, are very few, weak and poor. They cannot be more numerous than just one Islamic community in one of the regions of our country. And you, may the good Lord save, are not aware of the Muslims under our government, that we are the rulers of their kings and we always treat them well, and their kings live with us wearing golden crowns and riding horses? And are you not aware, you and your Sultan, that the River Nile is flowing to you from our country and that we are capable of preventing the floods that irrigate your country? Nothing keeps us from so doing only the belief in God and the care for His slaves. We have presented to you what you need to know and you should know what you have to do.[64]

Sultan Jaqmaq, however, was reluctant for the letter of Zara Yaeqob and in 1448 Abba Yohannes arrested, beaten, imprisoned and his property confiscated.[65] Besides, Abba Yohannes was forbidden from writing to the Ethiopian Emperor and ordaining for him any bishop or priest without his permission.[66] When Jaqmaq wrote a letter to the new Adalite sultan of Ethiopia suggesting that he has to make peace with Zara Yaeqob, the Adalite Sultan

[62] Butcher, Vol. II, PP. 229-230.
[63] Swanson, P. 124.
[64] Erlich, P.46.
[65] Butcher, P.124.
[66] El-Masri, Book III, P.212

responded in 1449 that Emperor Zara Yaeqob had built a navy of 200 ships in preparation for an attack on Mecca and he further warned that Zara Yaeqob has an intention to block the flow of Abbay.[67] The panic of Egyptians stated as:

> To add to the trouble of the Copts, news came that the king of Ethiopia was preparing to invade the Hijaz; and that he was going to accumulate impediments in the midst of the Nile at the borders of his country so as to stop its flow into Egypt. It happened in the following season that the inundation was so low that even the sultan began to be afraid. He asked the caliph to pray and he distributed money and clothes among the poor. A cry was sent out that all people were to go out to the desert and pray there. And such was the panic which prevailed that even the Copts were allowed to go out and pray. The multitudes continued to pray incessantly until God's Mercy overtook them, and the Nile began to rise. And the wonder of it is that the raise began in September in which time the eternal river usually reaches the height of its inundation.[68]

The rise of inundation in September certainly indicates as Abbay was diverted by Emperor Zara Yaeqob because the rainy season in Ethiopia is from June to September and hence rain fall starts in June, not in September. During the reign of Eskender (1478-1495) there was a similar trend. In 1488 an Ethiopian emissary was sent to Cairo and his speech reported as:

> In his silken tent-so we read of an audience in Cairo in 1488-the Sultan reclined on his divan, and the ambassadors of all the white powers kissed the ground twice before him. But the ambassador of the Negus was borne in on his litter, ignored the demand to rise, and reclining on his litter like the sultan, asked: 'Lord, will you have peace with your lord and mine, the Archpriest John?' 'My fathers were always at peace with that priest.' 'Say not, that priest, say my lord.' And when this preposterous demand had been repeated three times, the sultan said slowly: 'It is my wish to be at peace with my lord, the Archpriest John.' Then the Abyssinian presented the sultan of Egypt with a bow and six golden arrows, saying: 'It is well for you to say 'my lord.' In his hands lie your life and your death. You ask why? From our land comes the Nile. If my lord wished, he could cut off your water and you would all perish of thirst.' 'It is true,' said the sultan.[69]

Regarding this kind of periodic warnings, Hassan, an Egyptian writer, reports that "The Ethiopians periodically threatened to exterminate the Muslims and divert the Nile waters from Egypt so that its people would starve to death."[70] In 1496, Arnold Von Harff, a German

[67] Erlich, P.46.
[68] El-Masri, Book III, PP.212-213.
[69] Lindsay(trans.), The Nile, P.327
[70] Yusuf Fadl Hassan, "*The Historical Roots of Afro-Arab Relations,*" in The Arabs and Africa, (Beirut: Centre for Arab Unity Studies, 1984), P.3.

traveller, has confirmed the power of Ethiopians over Egyptians in controlling the flow of Abbay and not to be stopped the flow of the river, the sultan of Egypt had to pay yearly tribute to the Ethiopian Emperor.[71] Furthermore, Harff states that when Ethiopians came to Jerusalem no injury was to be done on them because of the fear that the flow of Abbay would be diverted.[72] In the sixteenth century, Emperor Lebena Dengel sent a letter to the pope of Portugal and he requested 'quarry men to dig through a hill, where [ancestors] formerly diverted the Nile, in order to turn it there again and damage Egypt.'[73]

In contrast to Ethiopia's initiative to divert the course of Abbay, modern Egyptian writers assert that the Portuguese had attempted to convince Ethiopian Emperors to divert the course of Abbay into the Red Sea.[74] William Lithgow, a Scottish writer, tells us that the Turkish sultan paid an annual tax of 50,000 gold coins to the Ethiopian Emperor in order to avoid the diversion of River Abbay.[75] Similarly, George Abbot, who was Archbishop of Canterbury as well as the fourth Chancellor of Trinity College in Dublin, reported as:

> The princes of Ægit have paid vnto the gouernor of the Abisines, a great tribute time out of mind; which of late, the great Turke supposing to be a custome needelesse, did deny; till the people of the Abisines by commandment of their prince did breake downe their dams; and drowning Egipt, did intorce the Turke to continue his pay, and to give much money for the new making of them very earnestly, to his great charge, desiring a peace.[76]

The yearly tribute paid by Egyptian sultans to Ethiopian Emperors was associated with the fear that Abbay would be diverted. In the eighteenth century, probably the last menacing letter to the Sultan of Egypt came from Emperor Teklehaymanot I (1706-1708) of Ethiopia. A letter sent to Cairo by Emperor Teklehaymanot presented by Bruce as:

> We could very soon repay you in kind, if we were inclined to revenge the insult you have offered to the man Murat sent on our part; the Nile would be sufficient to

[71] Muse Tegegne, Däqiqä Orit 'Gojjam' the Stigma: The Abyssinian Pariah, (Geneva: Guihon Books, 1993), P.25.
[72] Ibid.
[73] Fasil Amdetsion, "*The Scrutinizing the Scorpion Problematique: Arguments in favour of the continued Relevance of International Law and a Multidisciplinary Approach to Resolving Nile Dispute*," Texas International Law Journal, (Vol.44, No. 1, 2008), P.14.
[74] Hamdy A. Hassan and Ahmad al-Rasheed, "*The Nile River and Egyptian Foreign Interests*," in African Sociological Review, (Cairo: Cairo University Press, Vol. 11, No.1, 2007), P.30.
[75] Richard Pankhurst, *"Ethiopia's Alleged Control of the Nile*," in Haggai Erlich (eds.), The Nile: Histories, Cultures, Myths, (Boulder &London: Lynne Rienner Publishers, Inc. 2000), PP.32-33.
[76] Michael E. Brook, *Prester John: A Re-examination and Compendium of the Mythical Figure who helped Spark European Expansion*, (Unpublished Ph. D Dissertation, The University of Toledo, 2009), P.304.

> punish you, since God hath put in his fountain, his outlet, and his increase, and that we can dispose of the same to do you harm.[77]

From the letter of Teklehaymanot we understood that he knew very well about the diversion of Abbay by his predecessors.

There is plethora of evidence that signify as Upper Egypt had been invaded by Ethiopian Emperors repeatedly and it also accepted by modern writers but they cast a serious doubt on the technical capability of Ethiopian Emperors to divert the course of Abbay. For instance, the late professor Richard Pankhurst had attempted to underestimate the assertion of Ethiopians and fancifully concluded as 'claims of Ethiopia's ability to divert the Nile thus proved to be no more than roars of a paper lion.'[78] Similarly, the testimony given by al-Umari vilified by Erlich as 'However, in his writings al-Umari repeated al-Makin's version of the eleventh century story of the Ethiopia's blocking and subsequent freeing of the Nile. He thus contributed significantly to the recycling of that myth.'[79] Regrettably, writers like Teferi influenced by the work of modern writers considered the claim of Ethiopian Emperors as a myth.[80]

The assertions of Pankhurst and Erlich are not plausible. Their misunderstandings mainly emanated in identifying between the ancient territorial boundary of Ethiopia and the present-day Ethiopia. The present-day Sudan was part of the ancient Empire of Ethiopia. Regarding this, Lobo, a seventeenth century missionary, states that the ancient territory of Ethiopia extended 'from the Red Sea to the Kingdom of Congo and from Egypt to the Indian Sea.'[81] It was based on this historical reality that Emperor Menelik II of Ethiopia in his circular letter to Europe in 1891 declared that 'In defining today, the present border of my empire, I shall attempt, if God grants me life and strength, to re-establish the old frontiers as far as Khartoum and Nyanza.'[82] Furthermore, indigenous sources signify that Sennar was one of the tributary States of Ethiopia up to the second half of eighteenth century.[83]

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[77] James Bruce, *Travels to Discover the Source of the Nile, in the Years 1768, 1769, 1770, 1771, 1772, and 1773,* (London: Gregg International Publishers Ltd, Vol. 2, 1972), P.526.
[78] Pankhurst, P.31.
[79] Erlich, P.51.
[80] Teferi Mekonnen, "*The Blue Nile Issue: A History of Hydro politics, 1884-1974*,"(MA Thesis, Department of History, Addis Ababa University, 2004), P.18.
[81] Henry Morley(ed*.), A Voyage to Abyssinia*,(London: Cassel & Company Ltd, 1887),P.30.
[82] Muse, P.54.
[83] Weld Blundell (ed.), *The Royal Chronicle of Abyssinia, 1769-1840*, (London: Cambridge University Press, 1922), P.42.

Unaware of where the diversion of Abbay took place, Tellez argues as it is impossible to divert the waters of Abbay on the steep and rugged mountains of Ethiopia.[84] In fact, the spot of diversion for Ethiopian Emperors was not in present day Ethiopia. It was at Khartoum in Sudan and the name Khartoum derived from the verb *kärtämä,* meaning to break or to cut.[85] A French cleric, Abba Joachim Le Grand, under estimated Ethiopia's ability and declares that 'we do not pretend that a canal cannot be dug from the Nile to the Red Sea, but the Abyssinians cannot do it.'[86] In reality, diverting the course of Abbay to the Red Sea was an easier task than invading Upper Egypt for Ethiopian Emperors. Abba Gorgoryos, mentor of Job Ludolf, states that he had heard from persons of great credit that except a single mountain, the land towards the east was levelled and Abbay would rather flow towards it than in to Egypt.[87] In addition, Baker argues that 'I have seen a spot about 230 miles from the mouth of Atbara, where the river might be deflected without difficulty and be forced to an eastern course towards the Red Sea.'[88] In 1884, Baker recommended to the British government to occupy Khartoum in order to avoid the diversion of Abbay and his comment stated as 'If a civilized, even semi-civilized, enemy be in possession of that point, the waters of the Rahad, Dinder, Blue Nile and Atbara Rivers could be diverted from their course and dispersed throughout the deserts, to the utter ruin and complete destruction of Egypt proper.'[89] His recommendation seems acceptable by the British government because in the border treaty between Britain and Ethiopia in 1902, they inserted Art. III, as "The Emperor Menelik engages not to construct or to allow to be constructed any work across the Blue Nile, Lake Tana, or the Sobat which would arrest the flow of their waters in to the Nile."[90] Some writers had attempted to associate the acute water scarcity that Egyptians had faced at various times in the past with the fluctuation of the flow of Abbay. However, other sources do not support this claim. For instance, Meigh and others state that 'The floods of the Blue Nile are less variable than those of rivers in many parts of the world.'[91] Furthermore, the fluctuation in

[84] Pankhurst, P.33.
[85]Bairu Tafla, "*The Father of Rivers: The Nile in Ethiopian Literature*," in Haggai Erlich and Israel Gershoni(eds.), The Nile: Histories, Cultures, Myths, (Boulder &London: Rynne Rienner Publishers, Inc. 2000), P.161.
[86] Pankhurst, P.34.
[87] Ibid. P. 33.
[88] Donzel, P.127.
[89] William L. Langer," *The Struggle for the Nile*," Foreign Affairs, (Vol. 14, No. 2, 1936), P.262
[90] Hailu Wolde-Giyorgis, La Abbay Wuha Muget, (Addis Ababa: Addis Ababa University Press, 2001 E.C), P.304
[91] J.V. Sutcliffe & Y. P. Parks, "*The Nile and Its Tributaries*," in The Hydrology of the Nile, (IAHS Special Publication, No. 1, 1999), P. 138.

the flow of Abbay in the last century is limited either with an increase or a decrease of 20 percent in the total flow of Nile.[92] So such a fluctuation does not lead to starve to death.

In the second half of eighteenth century the Empire of Ethiopia was collapsed and the kingdoms were divided by regional war lords. Divided and weak Ethiopia without a strong central government continued for more than eighty years. This was an opportunity for Egyptians to reverse the situation. There is no doubt that Abbay was a threat to Egyptian national security because the source of Abbay on which their life is dependent lying beyond Egyptian borders.[93] So, State officials in Egypt in the nineteenth century feel unsafe unless they control the whole course of Abbay in their hands.[94] Accordingly, to control the Upper course of Abbay, Egypt under Muhammad Ali (1805-1849) invaded Sudan in 1820 and in 1830s his troops continued their invasion on the peripheral territory of north western Ethiopia.[95] It was from that time on ward that the power of balance shifted in favour of Egypt and Ethiopia remained under the threat of Egyptian leaders for the last two hundred years. To accomplish the dream of his grandfather and the advice of Munzinger, Khedive Ismail continued his invasion on Ethiopia aggressively. Munzinger, a Swiss born mercenary and a counsel of Khedive Ismail remarked that 'Ethiopia with a disciplined administration and army, and a friend of European powers, is a danger for Egypt. Egypt must either take over Ethiopia and Islamize it, or retain in anarchy and misery.'[96] Although the first option of Egypt ended in fiasco in 1876 at Gura, the second option is still underway. Egypt, for instance, supported Eritrean Liberation Movements during 1950s and 1960s and is thought that Egypt has provided military aid to Eritrea in the Ethio-Eritrean border war of 1998-2000. Egyptian national security interest in the last two hundred years has been always 'either to dominate Ethiopia or to neutralize whatever unfriendly regime that might appear there.'[97] This is because Abbay, on which Egyptians are dependent, emanates from Ethiopian highlands.

[92] Declan Conway, "*The Climate and Hydrology of the Upper Blue Nile River*," in The Geographical Journal, (Vol. 166, No. 1, 2000), P.58.
[93] Hassan & Rasheed, P.26.
[94] Langer, P.261.
[95] Hailu, PP.80-81.
[96] Sven Rubenson, *The Survival of Ethiopian Independence*, (Addis Ababa: Kuraz Publishing Agency, 1991), P.290.
[97] Fasil, P. 37.

4. Conclusions and Recommendation

Ethiopian Emperors, unless pre-occupied by internal problems, were zealous to respond for the cry of Copts. Whenever there was a persecution against Copts, Ethiopian Emperors responded either by invading Upper Egypt or by diverting the course of Abbay so as to stop the persecution. As the Amharic saying goes aptly 'no smoke without fire' and without something happened, the news of diversion would not be reverberated throughout Europe and Middle East. There is no doubt that Abbay was used as a trump card for Ethiopian Emperors in retaliation against the persecution of Copts. Ethiopia's ability in diverting the flow Abbay was not roars of a paper lion or a myth as some writers supposed. The ability of Ethiopian Emperors well supported by the letter of Zara Yaeqob as 'Nothing keeps us from so doing only the belief in God and the care for His slaves'. In the final analysis, it is safe to conclude that the course of Abbay was diverted at least by five Ethiopian Emperors namely, Lalibela, Dawit, Zara Yaeqob and two other lesser known Emperors of the Zagwe dynasty .If the diversion of Abbay had not been occurred, two things would unlikely to be happened. Firstly, Egyptians would not be affected by a terrible famine repeatedly. Any kind of drought in Ethiopia cannot be a seven years famine in Egypt. If the famine of 1066-72, for example, had been occurred due to a severe drought in Ethiopia, its reoccurrences will be continued within intervals at least until dams were built. Secondly, a threatening letter would not be sent by Ethiopian Emperors against Egypt to block the flow of Abbay. Ethiopian Emperors knew the disastrous consequences that Egypt had encountered in the past due to the diversion of Abbay and for that reason they sent menacing letters repeatedly to Egyptian Sultans. For instance, when Emperor Teklehaymanot said that 'the Nile would be sufficient to punish you' unless he had historical evidence that River Abbay had been diverted by his predecessors; this kind of warning is really unthinkable. Finally, I want to recommend for quantitative researchers to conduct their own research as to whether the occurrence of drought in Ethiopia can be a cause of famine in Egypt or not.

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Soil Property and Carbon Storage Variations Affected by Land Use Type in the Semi-Arid Ethiopian Rift Valley

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Abstract

This study examined the variations in soil properties, and carbon and nutrient storages under different land use types in the flood plains of Metehara, upper part of the Main Ethiopian Rift Valley. The study considered four land use types: cane plantation (CP), free grazing lands (FG), traditional maize farming (MF), and restored pasture (RP). The study established four transects with typical land use types and selected three soil sampling sites with 50m intervals from the upper-slope and the lower-slope position under each land use type. In each slope position, a 10m x 10m plot was established to collect the soil samples. A total of 24 distributed soil samples (3 land uses, and 3 replications) from 0 to 30 cm depth were collected using soil auger. The results indicate that the land use types significantly affected the soil parameters ($P<0.001$) whereas the slope position did not. The land use type explained the variations in soil carbon ($R^2 =0.77$, $P<0.001$, $df = 23$), and total nitrogen ($R^2 =0.39$, $P<0.05$). However, the results indicate insignificant effects on soil carbon and nitrogen variations when combining the soil properties covariate with land use factor in statistical model than the variation explained by land use type. The result also reveals that soil carbon (C) and total nitrogen (N) contents under the RP were significantly higher than the FG and MF sites. This study generally suggests how land use change has increasingly affected the semi-arid ecosystems and highlights the need to improve awareness about how human land use and land management decision impacts in the semi- arid areas of Ethiopian Rift Valley.

Keywords: Grazing, Exclosure, Management, Restored pasture, RiftValley

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1. Introduction

Soil degradation is a global threat, and a serious challenge in Ethiopia (Hurni, 1993; Daniel *et al.*, 2015). Soil degradation associated with inappropriate land use and management practices influences soil quality; particularly soil organic matter (Lemenih, et al., 2005; Solomon and Mohammed, 2016). The adverse effects of the land use changes on soil organic carbon and nutrient losses are more severe in arid and semi-arid regions, and are exacerbated by human inappropriate management practices. For example, deforestation associated with farming practices, overgrazing and forest fire was reported to reduce the soil organic carbon (SOC) by about 60-70% in the central Rift valley of Ethiopia (Fisseha, et al., 2011). The rate is significantly higher than the average loss of soil carbon recorded in tropical humid regions (Rhoades, *et al.,* 2000; Anderson-Teixeria, et al*.,* 2009).

Ecological restoration has been an important approach globally to mitigate human pressures on natural ecosystems, and reversing degraded ecosystems (Lal, 2001; Mekuria, et al., 2013). The approach improves soil quality through increasing a net primary productivity and biomass return to the soil, and is scientifically proven by some of the long-term experiments conducted in different regions including Ethiopia (Descheemaeker *et al.,* 2006; Bongers and Tennigkeit, 2010; Mekuria, et al., 2011). Although there are different restoration approaches, area exclosure is one of the commenest land managment options that has been adopted in Ethiopia over decades (Descheemaecker, et al., 2006; Mekuria, et al., 2007; Mekuria and Aynekulu, 2011). For instance, Mekuria et al. (2007) indicated 1.1 % of organic matter, 0.1 % of total soil nitrogen, and 1.8 mg kg^{-1} of available P increases after exclosure of degraded communal grazing lands in the semi-arid region of northern Ethiopia. Area exclosure also improved the soil organic carbon and nitrogen levels in semi-arid rangeland of Kenya though the effects vary under private and communal management systems (Mureithi *et al.,* 2014). In several other studies (Mengistu, et al., 2005; Tsetargachew, 2008; Tesfaye, 2011; Mekuria, et al., 2013), the adoption of long term area exclosure was found to improve the soil quality and vegetation cover of the degraded area.

Conversion of native ecosystem to agricultural land use affects the storage of soil carbon and nutrients cycling depending upon human management measures following the changes such as tillage methods, farming systems (intensity and crop types), soil fertility management techniques and others (Brye, et al., 2002; Wu, et al., 2003; Ogle, et al., 2005; Liu. et al., 2005). For instance, agricultural management practice that involves maize cultivation with

legume based rotation can restore as much as 20 tones C ha^{-1} when compared to maize monoculture in India (West *et al.,*2002). Similarly, fertilizer application significantly increased the concentrations of N, P, K and SOC in the plough layer of Chinese Mollisols (Liu, et al*,* 2005). In other studies, Delgado *et al. (*2011) indicated that retaining crop residues into soil to improve SOC and nutrient levels since most agricultural crop residues constitute nearly 40 to 50% of C. Similar conclusion was also made by Zeleke*et al.* (2004) who found 67% increases in SOC concentration in Andosols due to retaining maize (*Zea mays L*.) residue in farming system in South Central Rift Valley of Ethiopia.

In recent decades, human interventions on communal grazing land have put an increasing pressure on ecosystems and challenged the traditional resource use patterns in the semi-arid region of Ethiopian Rift Valley (Ayalew, 2001). These interventions were state-driven primarly focused on expansion of large-scale agriculure and establishment of protected area, and aimed to increase agricultural productivity and sustainability of the natural biodiversity at national level. While the traditional grazing land has catered for new land use functions, human pressure on an ever-decreasing grazing land may lead to unsustainable land use practice. One of the potential impacts of the land use change is the risk effect it poses on SOC and nutrient movements in the ecosystem. In this study, we used restored site that retired from grazing in the late 1960s, historically grazed site, and two agricultural land use sites that followed different management regimes. All the land use types were once under similar management condition used for communal grazing. The objective of the present study, therefore, was to identify the differences in carbon and nutrient storages under different land use types; and examine the effect of restoration on the level of soil carbon in the semi-arid Ethiopian Rift Valley.

2. Description of the study area

The study site is located south of Fentale Mountain that covered the Metehara plain, upper part of the Main Ethiopian Rift Valley (Figure 1).The area is characterized by the flat topography with an average elevation of 960 meter above sea level, and which increases towards north, south and southwest directions (Abule, et al., 2005). Geologically, it is a zone of different tectonic and volcanic activities that transformed the overall structure of the physiography (Mohr, 1971). The dominant soil types are Vitric Andosols, Eutric Fluvisols, Lithosols, Eutric Cambisols and Vertic Cambisols (FAO, 1984). The Vitric Andosols evolved

from volcanic ash of quaternary origin and overlaid by alluvium deposition derived from erosion of volcanic materials from the surrounding highlands (Gibson, 1969).

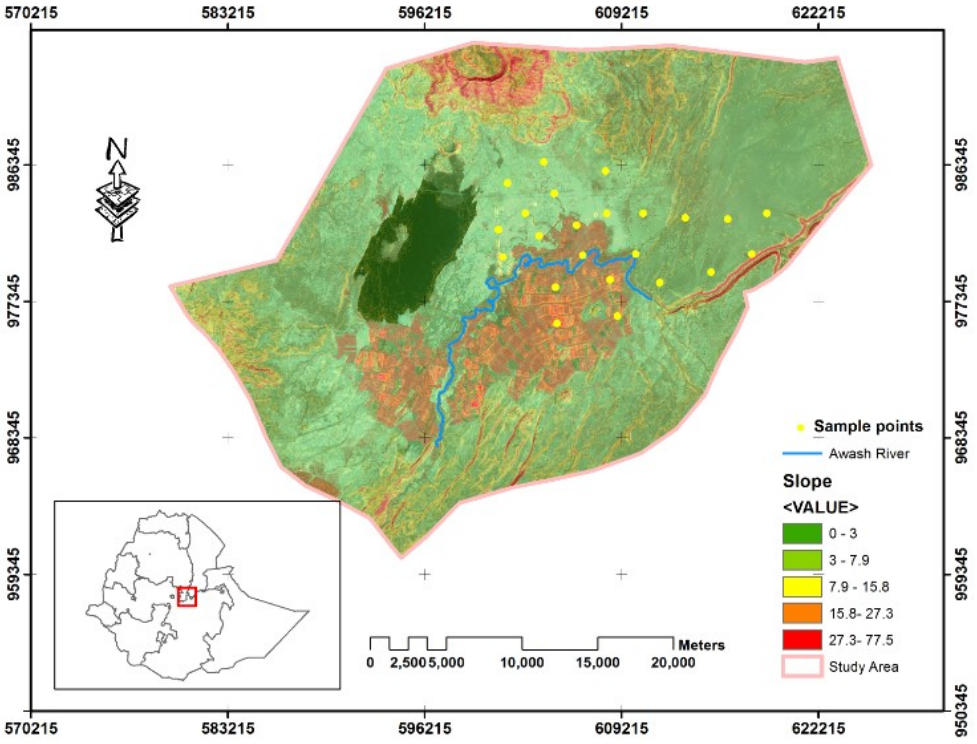


Figure 1 Map of the study site

Based on agro-climatic zonal classification, the area is described as semi-arid climatic zone (Daniel, 1977). Average annual precipitation recorded by meteorological station located on the plantation site is 531.7 mm (NMA, 2012). The temperature is generally high throughout the year wherein the mean maximum temperature of the three hottest months, and mean minimum temperature of the three coldest months are 34.6^0C and 13.8^0C, respectively. Ecologically, the area has been described as open savanna, a mixture of grasses and acacia species, together with patches of woody vegetation and riverine forest. It was predominantly used as dry-season grazing land before the introduction of alternative land use functions in recent decades (Jacobs and Schloeder, 1993).

2.1. Land use sequences

Communal grazing lands used to occupy a vast area of the Metehara plain where the local pastoralists have managed and controlled the resource regime in customary way for a century. However, extensive grazing land as land use system has been challenged over time with the introduction of alternative land use functions in recent decades. Currently, four land use and

managment practices have dominated the area. These include the restored pasture (RP), sugarcane plantation (CP), free grazing land (FG) and subsistance maize farming (MF).

The restored pasture (RP) was designated as Awash National Park (ANP) from exclosure made the communal grazing lands in 1969 (Solomon *et al.,* 2012). It was the first national park in the country to conserve the wild life resources, covering a total area estimated about 756 km^2 (Hailu, 1975). The restored pasture consists of various native vegetation dominated by acacia and perennial grass communities such as *A. tortilis*, *A. senegal*, *Chrysopogonplumulosus* and *Cymbopogon commutatus* (Jacobs and Schroeder, 1993; Abule *et al.,* 2005). Sugarcane (*saccharum sp.*) plantation (CP) also forms significant proportion of the present land use catagory. The practice of sugarcane growing dates back to 1960s conciding with the establishment of the ANP. The cane plantation has occupied more than 13,000 ha of land under eleven major fields with varied cultivation age ranging from nine to fifty-five years (Ayalew, 2001). The management of sugarcane growing has been undertaken using irrigation system and N-based fertilizer, averaging to 130 kg N $h^{-1}yr^{-1}$ (Ambachew, 2005).

Free grazing lands occupied the area outside the buffer zones of the sugarcane plantation and the ANP. Despite the current grazing regime started from a remote past, human pressures have intensified on use of the resource following the introduction of new land use functions, and resulted to change the customary way of resource management system and emerge the adoption of subsistence farming (Ayalew, 2001). Maize (*Zea mays*) was a major crop being produced with a roatation of sorghum (*Sorghum bicolor L.*), and finger millet (*Eleusinecoracana*) in some cases. Maize was grown based on seasonal rainfall without N-fertilizer application, and its residuals were harvested for fodder and fire wood.

3. Research Methodology

3.1. Soil sampling and analysis

The study used four land use and management sites for soil sampling namely cane plantation (CP), free grazing lands (FG), subsistence maize farming (MF), and restored pasture (RP). FG, CP and RP sites form a spatially contiguous series of land use cover types, whereas the MF site exists in small patches interspersed within free grazing lands. The sites are characterized by the flat topography where the slope position slighltly increases (2-10%) as far away along the river both in the left and in the right directions. Accordingly, the FG, MF

and RP sites were located to the left side of the river whereas the CP land use site was to right side of the river. From each land use category, four transects were drawn from the upper and lower slope positions. In each slope position, we selected three soil sampling sites at 100m interval and established 10 m x 10m plots to take the soil samples. To this end, small pits were dug to represent down to 30 cm depth at four corners and center of the plots to obtain composite soil samples. The study considered only the upper 30cm soil depth since the impact of cultivation on soil is significantly higher in the plough layer. A total of 24 evenly distributed soil samples (4 land use types, 2 slope positions and 3 replications) were collected for soil laboratory analysis. We also took equal numbers of undisturbed soil samples from each small pit located in the plots using a core sampler of known volume.

The samples were air-dried, ground, and passed through a 2-mm sieve to analze soil texture, soil pH, soil salinity (EC_e, dS m^{-1}), bulk density (BD), soil moisture content (MC), soil organic carbon (SOC), total nitrogen (TN) and available phosphorous (P). Percent in sand, silt and clay fractions was determined by the hydrometer method (Bouyoucos, 1962). Soil pH was determined in a 1:2.5 soil to water ratio suspension. Soil electrical conductivity (EC) was measured in saturation extracts and determined the degree of salinization (EC_e, dS m^{-1}), following the procedure illustrated by USSLS (1954). Soil bulk density (BD) was determined from the dry weigh per unit of known volume following the removal of the moisture content at 105^0C. Volumetric soil moisture content was determined as the ratio of the weight of the wet soil to the weight of the dry soil and multiplied by 100. Soil organic matter (SOM) was determined by loss on ignition method. Since the SOM contains 58% of C (Brady, 1985), the estimated SOM was further divided by a factor of 1.72 to determine SOC concentration for a given soil sample. Total nitrogen (TN) was measured by the Kjeldahl digestion procedure applying distillation and titration method. Available P was analyzed using Olsen extraction method (Olsen, et al., 1954). Soil organic carbon, nitrogen and Olsen- P stocks were determined for upper 30 cm soil depth using C, N and P concentrations, bulk density and conversion factors as follow:

$$SOC\ stock = \frac{C}{100} \times Bd \times D \times 10^4 m^2 ha^{-1}$$

$$N\ stock = \frac{N}{100} \times Bd \times D \times 10^4 m^2 ha^{-1}$$

$$Olsen\ P\ stock = \frac{P}{10^6} \times Bd \times D \times 10^4 m^2 ha^{-1}$$

Where: soil organic C (SOC), N and Olsen- Pstocks are in unit of (Mg m^{-3}), soil C and N concentrations are in unit of (%), Olsen-P concentration is in unit of (ppm), *BD* is soil bulk density (Mg m^{-3}), *D* is the soil depth (cm) and 10^4 m^2 $ha^{-1}$is a conversion factor.

3.2. Statistical analysis

The study employed multivariate analysis of variance (MANOVA) to analze soil texture, soil pH, soil salinity (EC_e, dS m^{-1}), bulk density, soil moisture content, soil organic carbon, total nitrogen and available phosphorous. The statistical analyses were considered with the design that included land use site (CP, FG, MF, and RP) and slope position (upper-slope and lower-slope) as main effect variables. In first analysis of a one-way MANOVA model, the study considered the overall effect of land use site and slope position on soil attributes using Wilks' lambda approximation test. Next to this, the study conducted a univariate F test (ANOVA) for all soil variables using land use site and slope position as the treatments. Fisher's protected least significant difference (LSD) test was applied for multiple comparison of the mean differences in soil attributes among land use sites and slope positions. All statistical analyses were performed using SPSS version 20.

4. Results and Discussion

The multivariate analysis of variance indicated that slope position did not significantly influence on the soil attributes (Wilks' lambda =0.166, F= 1.93, P=0.067). However, land use types had a significant effect (Wilks' lambda =0.009, F= 5.44, P<0.001) to control the soil attributes considered in the present study.

4.1 Physico-chemical soil properties under different land use types

Table 1 indicates results for physico-chemical properties for upper 30 cm soil layer among the land use types and within land use site. The proportions of sand and silt contents were similar among the land use types (CP, FG, MF and RP) though there was a non-significant trend towards higher sand content in FG site (Table 1). Relatively higher level of sand content in the FG site is more likely due to the impact of livestock grazing. The fraction of clay content varied among the land use types (P<0.01, F=5.03), and the CP site had higher clay content compared to the FG, MF and RP sites. However, this value was lower to that of Zeleke and Kibebew (2009) who conducted their study on the whole plantation site. The

results also indicated variation in soil texture particularly in sand contents within land use sites, and this variation was very high for FG (SD=11.5) and MF (SD= 10.5) sites. This variation might be due to differences in material distribution as the study site historically has experienced water flooding. In their studies, Chaneton and Lavado (1996) also identified differences in soil texture distribution along flooding plain of Pampa's grass land due to the exposure of the site to a frequent and long duration of water logging.

Table 1 Mean values ofphysico-chemical soil properties under four different land uses

Land use Types	Soil Texture Content (%)			Bulk density (g/cm^3)	Soil water content (%)	pH (H_2O)	EC_e (dSm^{-1})
	Sand	Silt	Clay				
CP	30.38± 3.9	33.5± 9.7	36.12±8.4	1.34±0.11	24.84±1.43	8.3±0.22	2.86±1.48
FG	42.48±11.5	30.27±6.1	27.25±5.45	1.35±0.08	19.78±1.33	8.34±0.29	1.85±0.39
MF	38.88±10.5	31.62±5.4	29.5± 6.2	1.30±0.05	18.76±2.16	8.46±0.36	2.44±0.83
RP	38.25±5.9	29.03±6.9	32.09±6.7	1.23±0.06	21.67±2.11	8.64±0.61	1.55±0.58

CP-cane plantation, FG - free grazing land, MF- subsistence maize farming, RP- restored pasture. Values are represented as mean ± Standard Deviation (n = 3).

Bulk soil properties varied among the land use types (P<0.001, F=9.82). On average, the bulk density ranged from 1.23 g/cm^3 in the RP to 1.35g/cm^3in the FG site (Table 1). Soil bulk density is affected by the land use and human management practices. Bulk density often increases with grazing intensity or from hoof traffic of grazing animals. Fantaw et al. (2015) in central part of the Ethiopian Rift Valley found higher bulk density levels in open communal grazing lands than sites under long period of exclosure, which are very comparable to the results identified in the present study. Commonly, a soil bulk density ranges from 1.2-1.4 g/cm^3in native vegetation cover (Walker and Desanker, 2004). Conversion of native vegetation to agricultural cultivation, however, increases the bulk density due to plowing effects on soil aggregates. The lower level of bulk density in the MF site than that of the CP site in the present study was probably due to the lower effect of hand plowing in traditional maize farming compared to plowing with heavy machinery where the effect on soil bulk density is often rapid. Despite large differences in sand fraction distribution between the CP and FG sites towards higher value in FG sites, our result surprisingly showed non-significant differences in soil bulk density between the two sites.

This may appear a little bit biased underestimating the value of bulk density in the FG site. On the contrary, the presence of extreme value (outlier) in our sample data of the sand particle distribution may partially exaggerate our results of the bulk density as well as particle size distribution in the FG.

Analysis of variance of soil salinity (EC_edS m^{-1}) indicated that there were significant differences (P<0.01, F=5.89) in salinity levels among the land use types. Generally, the level soil EC_ein agricultural land use types (CP and MF) were higher than the soil EC_ein the non-agricultural (FG and RP) land use types. Soil salinity is generally a concern in the study site due to underground water runoff discharged from the adjacent saline Lake Beseka. High EC_e values in some of the measured samples in the present study also indicated the presence of significant amounts of soluble salts, and relatively higher in lower slope than the upper slope of the site position. Despite this fact, our results generally showed lower soil salinity EC than reported previously in alkaline soils such as (Rietz *et al.,* 2001) in semi-arid area.

The lower accumulation of soluble salts found in this study might be associated with the frequent and prolonged flooding over the sites because soil water logging events could lead to leach the accumulated salts (Chaneton and Lavado, 1996). The soil salinity less than 2 dS m^{-1} was also reported in alkaline soils of semi-arid Kenya (Mureithi *et al.,* 2014) at swampy and seasonally flooded site. Our results, however, showed higher levels of soil salinity in the CP site compared to other sites, suggesting human cultural practices related to water and soil management practices to increase the level of salinity in irrigation based agricultural practice. Continuous grazing increases salt content by reducing aerial plant and litter cover, which lead to higher soil temperatures and evaporation rates in arid and semi-arid environments (Chaneton and Lavado 1996). In spite of this, our findings rather did not show a significant difference in soil ECe between grazing (FG) and restored pasture (RP) sites.

4.2. Soil carbon and total nitrogen contents under different land use types

There were significant differences in concentrations soil carbon (P<0.001, F=54.03) and soil total nitrogen (P<0.001, F=17.71) among the land use types (Table 2).

Table 2 Soil carbon, total nitrogen and available P concentrations at four land use types.

Land use types	% C	%N	C: N	Av. P	C density (g/cm^3)	N density (g/cm^3)	P density (g/cm^3)
CP	1.14a	0.085a	14.02a	9.37a	0.0153a	0.00114a	0.000013a
FG	0.98b	0.096a	10.59b	5.69a, b	0.0132b	0.00131a, b	0.000008a, b
MF	0.82c	0.068b	12.05b	3.46b	0.0105c	0.00088b	0.000005b
RP	1.36d	0.121c	11.33b	5.93a, b	0.0162a	0.00144a, b	0.000007a, b

CP- cane plantation; FG- free grazing land; MF- subsistence maize farming, and RP, - restored pasture. Means with different lowercase letters within a column are significantly different for $P < 0.05$ using the LSD test.

The concentrations of soil carbon, total nitrogen and available phosphorus identified in this study generally very low values according Landon's (1991) classification. However, the land use types considered un this study had varying levels of soil carbon, nitrogen, and available phosphorus contents due to differences in land management that have been practiced over decades. Accordingly, the amount of soil carbon and nitrogen contents in restored pasture (RP) was much higher than observed in CP, FG and MF sites. This might be attributed due to the effect of area exclosure since retirement of pasture land from grazing improves vegetation cover and organic matter input. This was proven by Mekuria et al. (2009) who found an increase of soil carbon from 36% - 50% due to the exclosure of communal grazing lands in the semi-arid land of northern Ethiopia. In similar study, Tsetargachew (2008) indicated increases of OM and TN at 2.3 % and 0.08%, respectively, after 20 years of exclosure of pasture land in Central Rift Valley of Ethiopia.

The result also indicates that the amount of both the soil carbon and nitrogen contents were significantly higher in the CP compared to MF site (Table 2). This is probably justified due to differences in soil management practiced between the two farming systems. Conversion of previously uncultivated land to agricultural cultivation generally reduces soil carbon and nutrient levels though its magnitude among other things depends on human management practices (Solomon *et al.,* 2014). In the study site, the practice of sugarcane growing has been primarily depend on uses of N fertilizer and irrigation water compared to the traditional dry farming without fertilizer application and irrigation as well. This confirms the fact that improved management practices enable to increase and/or maintain the soil quantity through increasing productivity and soil organic matter. Towards this, Lemenih et al. *(*2005) reported

significantly higher level of both soil carbon and total nitrogen under mechanized farming than traditional farming due to the differences in soil management practices in south Central parts of the Ethiopian Rift Valley.

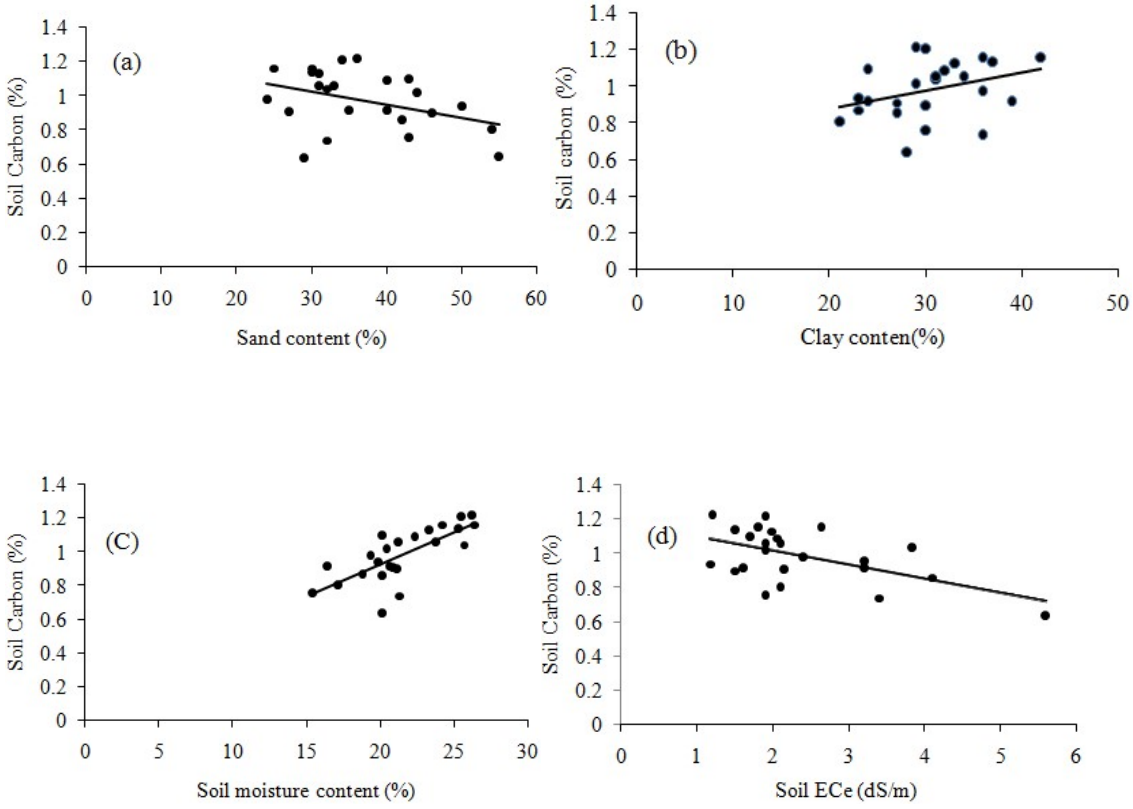
Soil C/N ratio reveals a slight though statistically consistent pattern of variations among the land use types ($P<0.05$, $F= 3.41$). Although the average C/N ratio for all land use types was about 12, it was generally higher in the CP site compared to FG, MF and RP sites (Table 2). This suggests higher rates of N losses in the CP site. The MF site (farming practice without fertilizer application) had slightly lower C/ N ratio than the CP site (farming practice with fertilizer application), and this suggests the MF site is less 'labile' to soil organic matter. This result is comparable to that of Walker and Desanker (2004) who found the C/ N ratio (averaging 12 at the surface soil) in older agricultural sites that converted from woodland-savanna in Malawi.

Phosphorus is one of the most limited nutrients in the tropics due to its adsorption on oxides, and clay minerals making unavailable to plants (Oberson *et al.,* 2001). However, the finding of this study did not indicate a significant difference in soil level of available phosphorous among the land use types ($P> 0.05$, $F=1.49$). This suggests difference in land use types was not a significant factor for soil available P in the study area. The availability of P is more problem in alkaline and calcareous soils due to formation of poorly soluble calcium phosphate raw materials, and fixation of applied P (Mohammod *et al.,* 2013). The mean value of available phosphorus (6.2 ppm) calculated from all sample sites in this study was generally very low according Landon's (1991) classification. Despite this fact, a higher level of available P in the CP than the MF site within agricultural land use system is likely due to the ongoing soil management efforts. The soil phosphorus may also available from off-site effect due to the soil erosion process and surface runoff (Messiga *et al.,* 2013) despite our data did not verify this fact. The observed P levels were rather very low in both the FG and RP sites in the present study suggesting plant productivity in the area would be primarily limited by P supply.

4.3. Factors influencing the Soil Carbon and Nitrogen Levels

The result also reveals the effect of soil physico-chemical properties on soil carbon and nitrogen through independent plotting of the soil physical properties (clay, silt and moisture contents) against soil organic carbon and nitrogen for the entire data set. The soil carbon content had significant correlation with covariate of soil properties including sand and clay

fraction contents (Fig. 2a & b), moisture content (Fig.2c) and soil EC_e (Fig. 2d). Regardless of the land use types, soil physical properties such as soil textural class and moisture content are an important control on soil carbon and nitrogen storages. In general, soil carbon storage increases as clay content increases since higher fraction of clay particles can protect and stabilize the soil organic carbon from microbial disturbance (Walker and Desanker, 2004). While the content of total nitrogen was correlated with silt content (Fig. 2e) and soil EC_e (Fig. 2f), soil pH is the only variable that had significant correlation with available P.



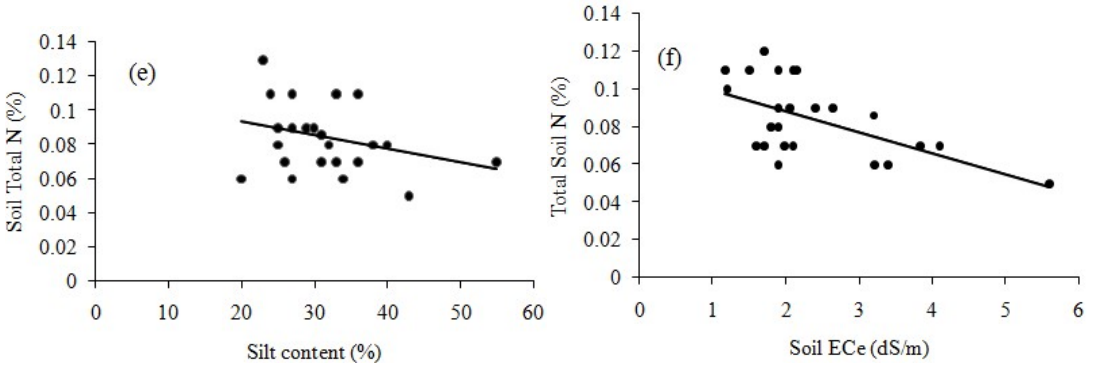


Figure 2 The relationship of soil organic C with sand (a), clay (b) fraction contents, soil moisture (c), soil ECe d); and soil total N with silt fraction content (e), soil ECe (f) determined at P< 0.05.

The stepwise multiple regression constructed using the soil property covariates was able to explain the variation in soil organic carbon (R^2 = 0.54; P<0.001) and total nitrogen (R^2 = 0.39; P<0.05) levels. On the other hand, the land use type explained the variations in soil carbon (R^2 =0.77,P<0.001, df = 23), and total nitrogen (R^2 =0.39, P<0.05).All soil properties combined with the site in regression model were able to explain the variations in soil carbon (R^2 = 0.82; P<0.001) and total nitrogen (R^2=42, P<0.01). This indicates insignificant effects on soil carbon and nitrogen variations when combining the soil properties covariate with land use factor in statistical model than the variation explained by land use type. This suggests that land type was the primary factor controlling the distributions of soil organic carbon and nitrogen levels.

Soil EC_e was a substantial contributor to explain the variations both in soil carbon and total nitrogen in this study. Salinity is a common problem in agriculture, which usually induced under irrigational farming. High salts content not only affect physical and chemical properties but also affect microbiological properties of the soil. In the present study, the soil salinity (EC_e) was found to correlate negatively both with soil carbon and total nitrogen levels though the effect was stronger on the soil total nitrogen than soil carbon. Increases in salinity have been shown to decrease soil respiration rates and the soil microbial biomass (Jackson and Vallaire, 2009).

4.4. Soil Carbon and Total Nitrogen Stocks (Mg Ha^{-1}) Under Different Land Use Types

The mean values of both the soil carbon and total nitrogen stocks were higher under the RP followed by the CP, FG and MF (Figure 3a & b). The average differences of the restored pasture to that of the CP, FG and MF sites varied from 2.55 (± 1.85) to 16.93 (± 2.04) Mg ha^{-1} for soil carbon stocks, and 0.404 (± 0. 06) to 1.68 (± 0.34) Mg ha^{-1} for total nitrogen stocks.

These indicate about 6 - 44% and 11- 53% increases of the soil carbon and total nitrogen stocks, respectively.

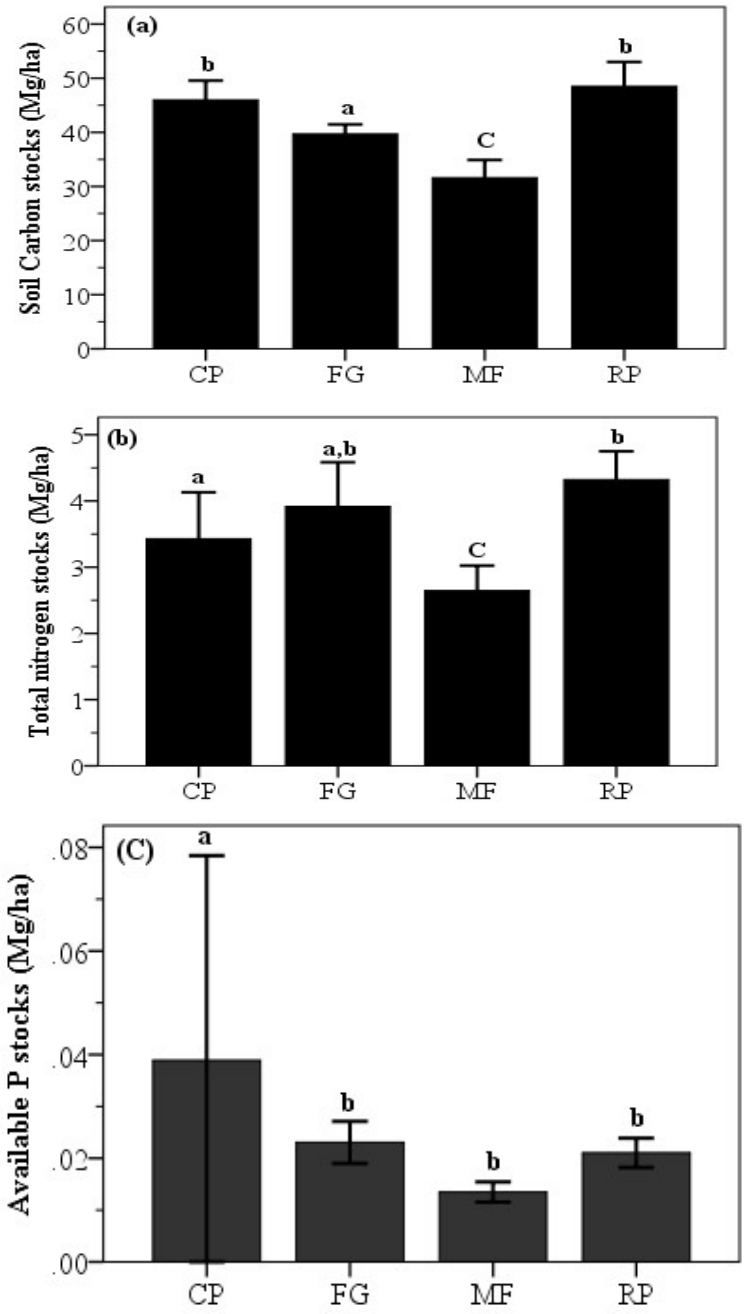


Figure 3 The soil carbon(a), total nitrogen(b) and Ava. P stocks (c) under different land use types: CP- cane plantation; FG- free grazing land; MF- subsistence maize farming, and RP,- restored pasture. The error bars represent the standard deviation of the mean

In comparison to the soil C content of the FG site (39.7± 1.5 Mg/ha), the soil C contents in the RP site (48.5 ±2.04Mg/ha) was approximately 10 Mg/ha higher (Fig.3a) in the present study. The observed soil C gain of 23% (i.e., 10 of 39.7 Mg/ha); however, is very lower

compared to the soil C gains that reported in previous studies for similar environmental setting. This might be due the differences in management practices and socio-economic setting surrounding protected area. Area exclosure is a land management option whereby livestock and humans are excluded from openly accessing of the area. However, most of the existing protected areas in Ethiopia including the Awash National Park (ANP) have been loosely regulated, being increasingly faced human pressures attributed to land use and socioeconomic dynamics surrounding them (Asebe, 2012; Anteneh *et al.,* 2014; Solomon *et al.,* 2014). Area exclosure under the restricted human and animal access supplemented with plantings of native and/or exotic species can improve the soil quality (Birhane*et al.,* 2006) than observed in the present study.

5. Conclusion

The study attempted to compare the measurement of soil properties, and carbon and nutrient storages among four land use types which had different management history. The findings revealed the effects of grazing land retirement on soil properties improvements, particularly on soil carbon and total nitrogen contents. However, the estimated soil organic carbon and nitrogen contents under the current restoration measures are lower than exclosure under strict regulation measures. Area exclosure under restricted human and animal access together with appropriate management interventions is a key to accelerate self-regenerating potential of an ecosystem and improve the soil quality better than observed in the present study.

Agricultural use disturbs the flow of soil carbon and nutrients in the ecosystems. However, the effect is not the same since the capacity of soils to store soil carbon and nutrient levels depends on human cultural factors, which in turn vary in space and time. As a result, soil carbon and nutrients under human managed ecosystems have been rarely maintained to pre-disturbance levels even in agricultural systems that use relatively improved management practice over traditional farming. This study may justify the notion that how human land use and management practices have caused the variations in soil properties, and carbon and nutrient storages. From management point of view, these further demonstrate how land use change have increasingly affected semi-arid ecosystems and highlight the need to improve our knowledge of human land use and land management decision impacts in the semi- arid areas of the Ethiopian Rift Valley.

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Agricultural Extension Training and Women's Participation in Ethiopia: Insights from District Level Services

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Abstract

Development agents (DAs) are assigned in the local administrations called Kebeles to provide training/advising services to smallholder farmers. In this contribution, the participation of women farmers is compared with that of male farmers in the context of Ankasha district, Awi Zone, Ethiopia. Annual reports on number of trainees were accessed from the district department of Agriculture (2011-2014). Basically, reviewing district reports was done followed by interviewing experts (N=9), DAs (N=6), and organizing 3 Focus Group Discussions with farmers (N=31) each composed of 10-11 individuals. All experts, DAs, and farmers were selected purposively. The Focus Group Discussions were organized in three Kebeles which were selected using lottery method of simple random sampling from 33 Kebeles in the district. To prioritize factors that contributed to low participation of women farmers and to get participant farmers' perceptions, the study used Likert scale type of questionnaire. The results revealed that illiteracy, poor mainstreaming of gender in the agricultural sector and priority to widowed or divorced women farmers as the first, second, and third (respectively) important factors to contribute to low participation of women farmers in the training services provided by the district. Thus, largely, women farmers' participation was found nominal. The extension training and advising services provided by DAs have to consider all women farmers (widowed, divorced, married, and bachelorettes). In the study context, women of all social status are participating in the farming activities of pre-planting, during-planting, and after-planting. And, there is a need to design a training programme in line with these activities for women farmers of all social status. The study will have theoretical contribution to adult learning theory and gender development or mainstreaming. This is the first study to evaluate district level training services as related to the number of women farmer participants in the public agriculture-related education programmes.

Keywords: *Agricultural extension, Gender, Training, Productivity performance, Awi, Ethiopia*

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1. Introduction

From the global survey of 115 countries by Food and Agriculture Organization of the United Nations (FAO) in the 1980s to the micro-studies by World Bank and International Food Policy Research Institute (IFPRI) in 2010, numerous studies show access to extension services is lower for women as compared with men (World Bank and IFPRI, 2010; Ragasa, 2013). And, it is reported that the exclusion of women from the extension services affects agricultural productivity and efficiency which undermines development agendas. Unless there is recognition to the different contributions of men and women in the sector, rural development projects and programs will be mismanaged and the results will be poor agricultural outputs and incomes, and food and nutrition insecurity. According to the World Bank findings (2001), ignoring gender inequalities contributes to people's ill-being and limits countries' abilities to grow sustainably and thereby reduce poverty. Yet, in Sub-Saharan Africa; as documented by studies of the World Bank (2005a) for different countries, considering the "missed potential of women" in agriculture results in good outcomes; for instance: shifting labor and fertilizer between men's and women's plots could increase output by 10 to 20 percent (Burkina Faso); giving women farmers the same inputs and education as men could increase yields by more than 20 percent (Kenya); reducing time burdens of women could increase cash incomes for smallholder coffee and banana growers by 10 percent (Tanzania); and if women enjoyed the same overall degree of capital investment in agricultural inputs, including land, as their men counterparts, output in Zambia could increase by up to 15 percent (Zambia).

Owing to these facts, Ethiopia as one of the Sub-Saharan African country, has invested much on public agricultural services (Belay, 2004). The agricultural sector and institutions that support it, such as extension is thus believed to be the key to poverty reduction in Ethiopia. Particularly, beginning in 2003 (10-12 July) with the Maputo Declaration, the Government of Ethiopia began an unprecedented public investment in the agricultural sector (Davis, et al., 2010). It demonstrated its commitment to allocate 10% of the national budget to agricultural reform which gives priority to women farmers and the youth in general. Ethiopia's commitment to rural development in general and public extension in particular is assumed to modernize and revitalize its agriculture through improved and new crops, livestock, and Natural Resource Management (NRM) technologies (Gebremedhin, Hoekstra, & Tegegne, 2006).

To maximize yield in the crop production, NRM, and livestock sectors, DAs were assigned in the Kebeles to professionally train/advise farmers (both men and women). However, their training is inclined to helping largely either male adult farmers or those of women (widowed or divorced) who are heads of the household. And, large number of husbanded women or bachelorettes farmers are ignored which is against the commitment of government in the Maputo Declaration. Nevertheless, many studies (Whitehead & Kabeer, 2001; Kes & Swaminathan, 2006; Kilic, Winters & Carletto, 2015; Farnworth & Colverson, 2015) reported the importance of empowering women farmers of all social status to achieve food security in sub-Saharan African countries. Earlier than these studies; of course, Saito and Weidemann (1990) stressed that raising the productivity of women farmers must be the centrepiece of agricultural strategy in order to improve household food security in Sub-Saharan African countries.

However, researchers still reported gender-biased services provided by gender-blind organizations in Ethiopia (Buchy & Basaznew, 2005; Yu, Nin-Pratt, Funes, & Gemessa, 2011). Not only that but it is asserted that in comparison with men, women farmers in Ethiopia are principally disadvantaged since they have limited access to productive assets including irrigation water, credit, extension services, and rural institutions which put them in difficult situations to implement innovations (Mulema, Farnworth, & Colverson, 2016). Also, the biases in rural advisory services are often caused by the belief that men are created for farming; that is, managing livestock and crops meant for the market whilst women are created for gardening; that is, operating largely outside the market economy. In this regard, the Women's Development and Change Extension Package of Ethiopia assumes that women garden rather than farm, and thus provides advice related to home gardens and poultry (Cohen & Lemma, 2011).

In sum, in Ethiopia, the existence of gender variation on farmers' productivity due to labor, resource endowment, access to information (extension) and cultural taboo constraints were discovered (Pender & Gebremedhin, 2007). There are also estimations indicating that male-headed households have 5% higher farm productivity than female headed households (Elias, 2013) and the variation in productivity differences are attributed to the factors enlisted earlier (Pender & Gebremedhin, 2007). This study; thus, is aimed at filling this gap since the current public extension services delivery expects married and bachelorettes women farmers to understand the extension packages and improve productivity without being involved in the extension training services offered by DAs. It was conducted with the purpose of exploring

the status of women farmers' participation and discovering the main reasons that hinder their participation in the public extension services rendered by DAs within the context of Ankasha district as a case.

1.2. Theoretical Framework

The theory of adult education (Knowles, 1973) identified six principal features for adult learners; namely: adults are autonomous and self-directed; adults bring life experiences and knowledge to learning experiences; adults are goal-oriented; adults are relevancy-oriented; adults are practical; and adult learners like to be respected. In support of this, another most convincing argument is experiential learning theory which appears in Kolb's influential paper *Experiential Learning: Experience as the Source of Learning and Development* (1984), which made reference to a quote attributed to the Chinese philosopher Confucius (450 B.C.): *"Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand."* Besides, when a training programme is designed, scholars recommended the importance of paying attention to individual learner differences (Jonassen & Grabowski, 1993). That is, three core dimensions of individuals should be taken into consideration: a) cognitive (mental ability, attention, information gathering/organizing, learning styles); b) personality (ambiguity tolerance, achievement motivation, risk taking); and, c) prior knowledge (e.g., about the topic of extension training). Also, trainees should be coached very well and be given a task that helps them improve their performance; and they should be able to get proper feedback. Learning/training is effective when it is followed by feedback (Nicol & Macfarlane-Dick, 2006). The current scenario in the public extension training service delivery also demonstrates the relevance of workplace learning theory (Long, Ryan, Burke, & Hopkins, 2000). That is, extension training services should be able to consider farmer characteristics (age, sex, ethnicity, education, ability, motivation); job characteristics (planting, weeding, harvesting); farm characteristics (small plot, type of crop, soil, water needs of crop); socio-political and economic environment (price of inputs/outputs, policy issues on credit access, land use, land ownership certification). Accordingly, it is widely recognized that current agricultural extension approaches should be based on these theoretical assumptions.

In this study, training is defined as: "the acquisition of skills, concepts, or attitudes that results in improved performance in an on-the-job environment" (Goldstein, 1980, p.230). Recognizing the theoretical assumptions of adult education, experiential and workplace

learning, individual learner differences, and feedback to the public extension training services and having conceptualized training, the study tried to answer the following research questions. To what extent women farmers participate in the public agricultural training services provided by DAs? If their participation is low, what are the principal factors that hinder their participation?

2. Description of the Study Area

This study was conducted in Ankasha *woreda* of Awi zone of the Amhara National Regional State (Figure 1). During the study time and according to the Ankisha *woreda* Census Office (2014), the total population of the *woreda* was 232,549 (112,825 males and 119,724 females). Taking the average family size of Ethiopia as five (CSA, 2010) the total population of the *woreda* is assumed to be 46,510 household heads. With the objective of increasing production and productivity, the agricultural office organizes training services which are offered by DAs in each kebele administration. During the study time, the total number of Development Agents (DAs) who were assigned to deliver agricultural extension training services in the *kebeles* were 194 (30 females and 164 males). All of them have Diploma (10+3) from the Agricultural Technical and Vocational Education and Training (ATVET) colleges. The DA-farmer ratio of the woreda was 1:240; that is, one DA is expected to provide training/advising services for 240 smallholder farmers. In Ethiopia, the national DA to farmer ratio is 1:476 (Davis, et al., 2010). Thus, the DA to farmer ratio is better in the woreda as compared to the national DA to farmer ratio. The woreda is known for growing varieties of crops such wheat, barely, maize, and *teff*.

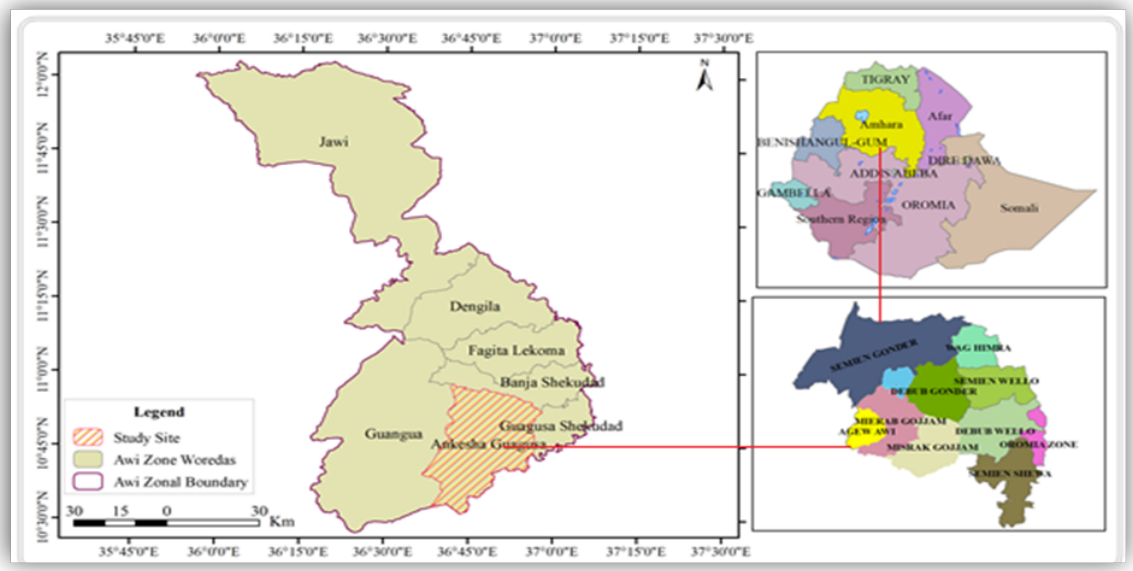


Figure 1 Locational map of study area

3. Research Methodology

Exploratory sequential mixed methods research design composed of qualitative and quantitative research methods was employed for the study. This is due to the fact that this kind of study is new to the study area. From the total (33 kebeles) in the *woreda*, 3 kebeles were selected using simple random sampling technique with the objective to give equal chance in representing the study *woreda*. Purposive sampling method was employed to select experts (N=9), DAs (N=6), and farmers (N=31).

3.1 Methods of Data collection

Mainly, reviewing the woreda reports was the main method of data collection. To further corroborate the reviewing process, data were also collected through conducting an in-depth interview with experts and DAs. To conduct a rigorous investigation of the problem under consideration, 3 (three) FGDs with both male and female farmers each composed of 10-11 individuals were organized. Discussions were held until data saturation was achieved and consensus was reached among the FGD participants. To facilitate and iteratively listen participants voice during data analysis, their voices were recorded and coded for experts, development agents, and farmers respectively.

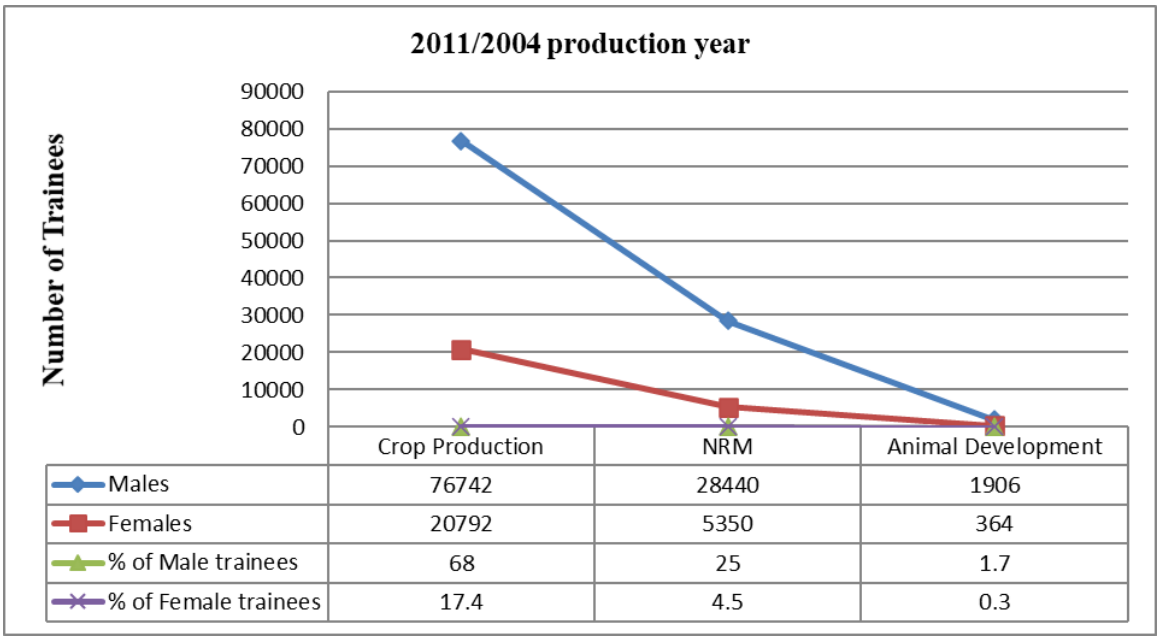
3.2. Methods of Data analysis

Data was analysed based on pre-defined themes: Natural Resources Management (NRM), Crop production, and Animal Development since training was provided by the woreda based on these three fields. Also, content analysis which involves coding themes that were repeatedly uttered by participants was used as a method of data analysis to identify reasons for low participation of women farmers. These reasons were later substantiated by supportive direct quotes from the participants recorded voices made during verbatim analysis and references from literature sources. To rank the reasons for low participation of women farmers in descending order, descriptive statistics was used to present data and arrange the results accordingly.

4. Results

4.1. Review of District Level Reports

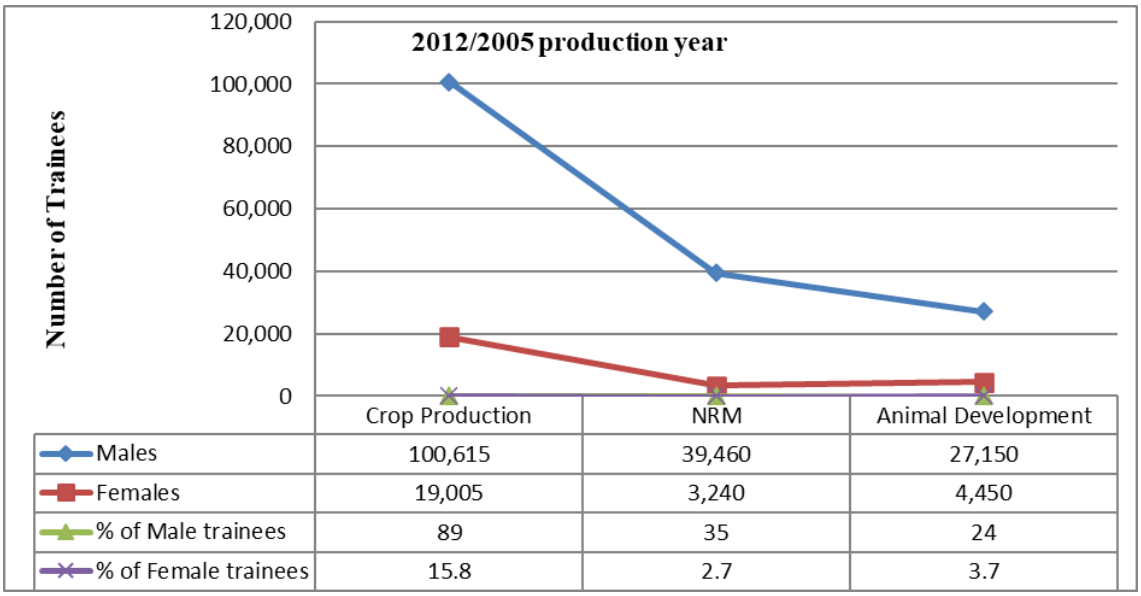
Annual reports review was made by the researchers. The unpublished annual district level department of Agriculture report (2011) showed the delivery of training on three fields of extension package: Crop production, Natural Resources Management (NRM), and Animal Development. In the report, 68% of male and 17.4% of female trainees received training on crop production. Similarly, 25% of males and 4.5 % females received training in Natural Resources Management. The number of trainees for animal development was 1.7% for males and 0.3 % for females. The following graph (Fig. 1) summarized the findings from the reviewed report. Comparison made on the number of trainees in the three fields of extension package showed that relatively large number of trainees were registered in the crop production field and the number of registered trainees in the Animal development package was nearly insignificant (Fig. 1).



	Crop Production	NRM	Animal Development
Males	76742	28440	1906
Females	20792	5350	364
% of Male trainees	68	25	1.7
% of Female trainees	17.4	4.5	0.3

Figure 2 Number of male and female trainees for three fields of extension packages.

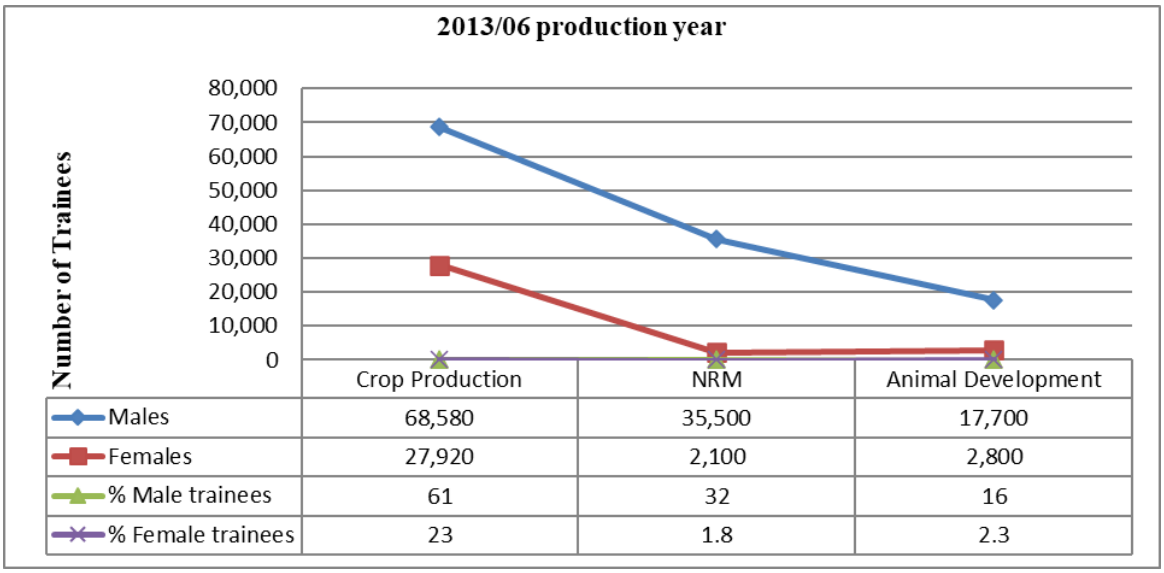
The second report review made by the researchers was that of unpublished annual district level department of Agriculture report (2012). Like the previous year, delivery of training on three fields of extension packages was registered: Crop Production, Natural Resources Management (NRM), and Animal Development. In this report, 89% of male and 15.8% of females received training on crop production while 35% of males and 2.7% of females received on NRM. Relatively better than earlier year, 24% of male trainees and 3.7% of female trainees received training on animal development. However, the number of trainees in animal development was still less as compared to crop production. Figure 2 summarized findings from the reviewed report.



	Crop Production	NRM	Animal Development
Males	100,615	39,460	27,150
Females	19,005	3,240	4,450
% of Male trainees	89	35	24
% of Female trainees	15.8	2.7	3.7

Figure 3 Number of male and female trainees for three fields of extension packages

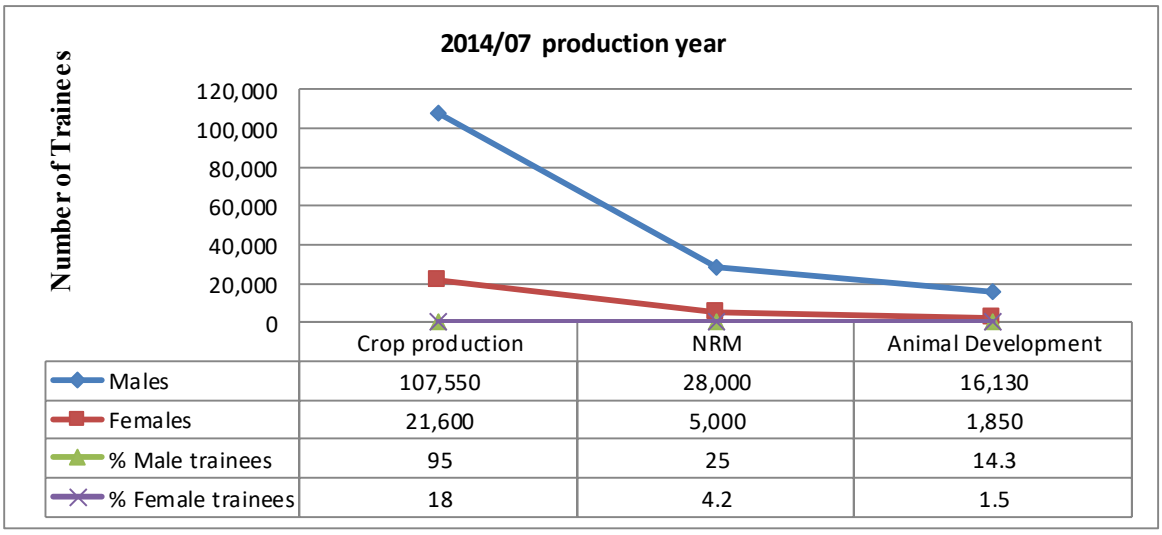
The third report review made by the researchers was that of unpublished annual district level department of Agriculture report (2013). Like the two previous years' report, the number of trainees for crop production was 61% and 23 % for males and females respectively. The number of trainees for NRM was computed 32% and 1.8% for males and females respectively. Animal development trainees were found still less for both males and females as compared to the other fields of extension packages (Figure 3).



	Crop Production	NRM	Animal Development
Males	68,580	35,500	17,700
Females	27,920	2,100	2,800
% Male trainees	61	32	16
% Female trainees	23	1.8	2.3

Figure 4 Number of male and female trainees for three fields of extension packages.

The fourth report review made by the researchers was that of unpublished annual district department of Agriculture report (2014). In this report, 95% of males received training on crop production training while 25% and 14.3% of them received on NRM and animal development respectively. Similar to the earlier three reports, the number of female trainees in all the three fields of extension package was found less (Figure 4).



	Crop production	NRM	Animal Development
Males	107,550	28,000	16,130
Females	21,600	5,000	1,850
% Male trainees	95	25	14.3
% Female trainees	18	4.2	1.5

Figure 5 Number of male and female trainees for three fields of extension packages.

From the four graphs, we learnt that the percentages of women farmers' participation was found between maximum 23% and minimum 0.3% while that of male farmers' was between

maximum 95% and minimum 1.7%. This informed us high range among women and male farmer trainees while their total population covered 51.1% of the district (District Level Census Office, 2014). Also, it is to be noted that the percentage of male and female trainees in the four reports included those who received repeated training. If the females who took training repeatedly were identified, the percentage would be less than the numbers computed in the figures. Unfortunately, the *district* failed to identify those who took the training repeatedly; which is an indicator of a training programme given without a good plan.

Following the end of our district report evaluations and as stated elsewhere, we organized in-depth interviews with experts and DAs followed by FGDs with farmers. The demographic and socio-economic characteristics and the results obtained from the successive discussions are presented below.

4.2. Profile of Study Participants and Empirical Findings

As illustrated in Table 1 below, male participant experts and DAs constituted 77.8% and 66.7% while female participants represented 22.2% and 33.3 % respectively. The main reason to take large number of male experts and DAs was due to a smaller number of females at the level of experts and DAs in the district and Kebeles. However, the number of farmer participants was made to compose large number of female participants (74.2%) as compared to male participants (25.5%). Based on Tarekegne, Wesselink, Biemans & Mulder (2017) classification of age, 33.33% of experts, 100% of DAs, and 29.03% of farmers belonged to the early career age group while 66.7%, 0%, and 70.97% of them respectively belonged to the mid-career age group. Nevertheless, no participant was registered in later career age group which may be informative that the agriculture work force is dominated by the productive mid-career age group (cf. Tauer,1995). Experts (33.3%) and DAs (66.7%) had work experiences between 1-10 years while 66.7% of experts and 33.3% of DAs had work experiences between 11-20 years. There were no experts and DAs with working experiences between 21-30 years. When we looked at the farming experiences of farmer participants, 16.12% of them had farming experiences between 1-10 years while 51.61% of them had experiences between 11-20 years. Unlike experts and DAs; however, 32.27% of them had farming experiences between 21-30 years. Related to their level of education, 100% of experts and 16.67% of DAs received their BA/BSc degrees while 83.33% of DAs were diploma (10+3) graduates from ATVETs. Yet, the level of education of farmers was at the level of basic literacy (25.81%) and illiteracy (74.19%). The fields of specializations of

experts and DAs were dominated by the three disciplines equally: natural resources management (33.33 % of DAs and 33.33 % of experts), animal production (33.33% of DAs and 33.33% of experts), and crop production (33.33% of DAs and 33.33% of experts). The marital status profile of experts was 55.56% (married) and 44.44% (bachelorette /bachelor) while that of DAs was 33.33% (married) and 66.67 % (bachelorette /bachelor). Similarly, the marital status profile of women farmers was found as follows: widowed (32.26%), divorced (29.03), married (25.81%), and, bachelorette (12.91%). See Table 1 below.

Table 1 Demographic and socio-economic characteristics of participants

Variables	**Experts (interview)**		**DAs (interview)**		**Farmers (FGDs)**	
	N=9	**%**	**N=6**	**%**	**N=31**	**%**
Sex						
Male	7	77.8	4	66.7	8	25.8
Female	2	22.2	2	33.3	23	74.2
Age group						
Early career (23-35 years)	3	33.3	6	100	9	29.03
Mid-career (36-55 years)	6	66.7	0	0	22	70.97
Later career (56-75 years)	0	0	0	0	0	0
Work experiences/farming experiences						
1-10 years	3	33.3	4	66.7	5	16.12
11-20 years	6	66.7	2	33.3	16	51.61
21-30 years	0	0	0	0	10	32.27
Level of education						
Degree	9	100	1	16.67	0	0
Diploma (10+3) from ATVETs	0	0	5	83.33	0	0
Basic Literacy	0	0	0	0	8	25.81
Illiterate	0	0	0	0	23	74.19
Field of specialization						
Natural resources management	3	33.33	2	33.33	0	0
Animal production	3	33.33	2	33.33	0	0
Crop production	3	33.33	2	33.33	0	0
Marital status						
Widowed	0	0	0	0	*10*	32.26
Divorced	0	0	0	0	*9*	29.03
Married	5	55.56	2	33.33	*8*	25.81
Bachelorette/bachelor	4	44.44	4	66.67	*4*	12.90

The interview sessions we held with Experts and DAs and the FGDs with that of farmers themselves outlined reasons for less participation of women farmers in the training services provided by DAs (see Table 2). We summarised the empirical findings supported by literature sources to maximize trustworthiness of the study. According to Lincoln and Guba (1985), ensuring credibility is one of most important factors in establishing trustworthiness.

And, one of the methods of doing this is to assess the degree to which the current result is congruent with those of past studies. In this regard, Silverman (2001) also stated that the key criterion for evaluating works of qualitative inquiry is the ability of the researcher to relate his or her findings to an existing body of knowledge. That is, evaluating works of qualitative inquiry can be done through enhancing triangulation which has three primary purposes: convergence, complementarity, and dissonance (Erzerberger & Prein, 1997). Researchers can choose strategies of improving validity by triangulating their findings so that a more complete picture of the issue of interest under investigation is formed. Through ascertaining the complementarity of various data sources to existing body of knowledge, it is possible to generate multiple dimensions of the same research issue and thereby increase the level of our understanding (cf. Fielding & Fielding, 1986). Not only that but, if there are dissonance findings that diverge from previous studies, it is stated that, they will serve as a point of departure for future studies (Miles & Huberman, 1994) or enhance empirically-based hypothesis construction (Erzerberger & Prein, 1997). Thus, we followed the approach of supporting empirical findings with literature sources (Table 2).

Table 2 Reasons for low participation of women farmers, exemplary quotes and supportive references from literature sources

No.	Reasons for low participation of women farmers	Exemplar quotations	References
1.	Infrastructure constraint	'The root causes of agricultural crises in Africa are aggravated by...poor rural infrastructure...'	Maputo Declaration 7, 10 to 12 July, (2003,1)
		'The training centre is far from our residence'	FGD-2 participant woman farmer, FA.3
2.	Women engagement	'Rural women of all ages spend much of their day engaged in domestic chores, including collecting water and firewood, processing and preparing food, travelling and transporting, and care giving'	IFAD (2016,1)
		'Women are busy of all-rounded domestic chores...like household tedious task, pregnancy, caring children...and they give priority to this'	Interviewee expert, Exp.1
3	Husband/ Community	'In most cases women and youth are not invited to attend meetings and social discussions that	National Extension

	perception to the training	concern women and youth with the assumptions that men can convey the message to them'	Strategy of Ethiopia (2014, 32)
		'Perception held by husband in the sense that his attendance is enough to gain knowledge and skills and he believes that he can transfer to his wife'	Interviewee development agent, DA.1
4	Misconception about the training itself	'In most cases, the extension service is viewed by farmers as input delivery service while in fact it should have been knowledge broker and facilitator of linkages'	Gebremedhin et al. (2006, 23)
		'Training is good for the sake of attendance. Because, to access inputs like: fertilizer, better seeds, chemicals, credit, or technologies, I must attend the training'	FGD-3 participant male farmer, FA.11
5.	Cultural Factors	'A great majority of women do not participate in decision making or express their needs during meetings because of prevailing socio-cultural barriers which elevate the role of males in such forums'	National Agricultural Strategy of Ethiopia (2014,32)
		'My husband prefers my staying at home...If I start to get out, he will not feel comfortable...he may think that I used to behave as If I were not husbanded'	FGD-1 participant woman Farmer, FA.14
6.	Poor Mainstreaming of Gender in the Agricultural sector	'Given the extensive participation of women in all aspects of agricultural production, the mainstreaming of gender into the agriculture sector is a key strategy'	Commonwealth Secretariat (2001,7)
		'Both DAs and Kebele level agricultural experts lack knowledge on equality of opportunity'	Interviewee expert, Exp.5
7	Male Development Agents' Frustration	'The strength and orientation of the rural ideology have a unique influence on both gender role and gender relations'	Little (1987,335)
		'Women farmers are disadvantaged by the lack of female extension workers in areas where the cultural norms mean it is difficult for a female farmer to talk to a male extension worker'	McNamara et al. (2014,16)
		'Personally, I am frustrated to establish relation with husbanded women farmers for fear that their husbands will not be positive culturally'	Interviewee development agent, DA.5
8	Larger family size	'time is a precious commodity not only for scientists but also for farmers'...	Hoffmann et al. (2007,364)
		'women are responsible for feeding the family'	Doss (2001,2077)
		'I do have large number of families and caring them takes much of my time. And, I fail to attend training'	FGD-2 participant

			woman farmer, FA.7
9	Illiteracy	'Women are key actors in the process of economic development. However, they are being impeded by their very low levels of literacy and education'	Browne & Barrett (1991, 275)
		'I am not educated; I mean I cannot read and write. So, if I am going to attend the training, I feel that I will not understand the training. And, I prefer to remain at home'	FGD-1 participant woman Farmer, FA.19
10	Priority to Widowed/ Divorced women farmers	'Male bias is seen as lying in 'traditional' social structures, especially in the household and the state'	(Elson, 1995, vii)
		'DAs have also their own limitations. They usually include women who are divorced/widowed. They usually told our husbands to participate and do not tell us...their priority is head of the household'	FGD-2 participant woman farmer, FA.7
11.	Failure of agricultural researchers/scientists to coach DAs, or support farmers at grass-root levels	'Social distance between farmers and agricultural scientists [researchers] limited effectiveness of participatory learning'	Bentley (1994)
		'Researchers guide collective learning processes through playing three roles as: reflective scientist, intermediary, and facilitator'	Pohl et al. (2010, 277)
		'Researchers used to come to our district and interviewed us many times. They also requested us to fill questionnaires. However, nobody reports the findings to us and supports us based on the findings'	Interviewee expert, Exp.6

Note*: Exp.=expert; DA.= development agent; FA. = farmer*

4.2.1. Prioritizing factors affecting women farmers' participation

Farmer participants (N=31) of the study were also requested to prioritize the factors that affect women farmers' participation in the extension training services using a five point Likert scale type questionnaire stated as: 1= has no effect at all; 2= has of little effect; 3=has moderate effect;4= has high effect; and, 5=has very high effect. Thus, based on the perception of farmer participants, illiteracy, poor mainstreaming of gender, and priority to widowed or divorced women farmers were found to be the first, second and third (respectively) most important factors to contribute to women's less participation in the training services provided by district level agriculture departments. Refer Table 3 below which is arranged in descending order.

Table 3 Ranking the effects based on means computed from perceptions of farmer participants

Descriptive Statistics					
	Farmer Participants (N=31)	Minimum	Maximum	Mean	Std. Deviation
Illiteracy	31	3	5	4.19	.749
Poor mainstreaming of Gender in the Agriculture sector	31	1	5	3.90	.908
Priority to widowed or divorced women farmers	31	3	5	3.74	.575
Women engagement	31	1	5	3.68	1.013
Cultural factors	31	2	5	3.68	.909
Large family size	31	2	5	3.61	.715
Misconception about the training itself	31	2	5	3.13	.885
Husband/community perception to the training	31	1	4	2.61	.882
Infrastructure constraint	31	1	4	2.29	.864
Male development agents' frustration	31	1	5	2.10	1.106
Failure of agricultural researchers to coach DAs or support farmers at the grassroots levels	31	1	5	2.06	.855

5. Discussion

It was learnt that trainings were given in the three fields of extension packages in the selected district across the four years (2011-2014). Yet, the number of trainees of women farmers was very low in each field as compared to that of males. As indicated in the graphs above (Figure 1- Figure 4), the average participation of women revolves between 0.3% (for animal development) and 23 % (for crop production). From the district level Census Office unpublished report (2014), it was learnt that women constituted about 51.4% of the total population of the district. The current training services are largely inclined to male farmer trainees and giving equality of opportunity to all women farmer trainees (Widowed, divorced, husbanded, and bachelorettes) is absent in the context of the study. This study revealed the perception of the roles that men and women play in agriculture is biased towards men. As a result, perceptions about the need for extension advising/training services are also biased towards men though Ethiopia has enacted gender equality policies. Our finding concurs with the findings of other researchers who conducted a study on 'agriculture extension services and gender equality in Ethiopia' (cf. Cohen and Lemma, 2010) and the current agricultural strategy of Ethiopia which recognized poor gender and youth mainstreaming in extension programs planning, implementing and in monitoring, learning and evaluating (cf. Ministry of Agriculture and Natural Resources, 2017).

It is noted that adult learning theory informed us that adults are goal-oriented, relevancy-oriented, and practical-oriented. And any training programme which is designed to empower

adults should be based on these principles. However, the training offered to farmers does not consider all these principles and is not given based on sound planning, monitoring and evaluation of its outcomes. Women farmers are assumed to understand the extension package without being involved; that is, husbands are expected to transfer their knowledge and skill to their wives (cf. Kolb, 1984). The most important point to be considered here is that large numbers of farmers in Ethiopia are illiterate. Because of the complex nature of transfer, how an illiterate farmer is able to transfer the knowledge and skill he accessed from the training to his wife is questionable. It is to be noted that transfer is very difficult to happen (Perkins & Salomon, 1994). It needs mindfulness and reflective practices between the mentor and the mentee; that is, participatory training delivery facilitates the occurrence of transfer (Baldwin & Ford, 1988). In the interview held with experts, DAs, and FGDs with farmers, the training is offered also without proper feedback though effective training needs provision of proper feedback to trainees (Nicol & Macfarlane-Dick, 2006).

Learner differences are not considered; for instance, learning styles of trainees, personality, and prior knowledge (Jonassen & Grabowski, 1993). Though most of the trainees are adults and needs practice-oriented training (cf. Knowles, 1973), the training provided by DAs is found to be lecture method and largely theoretical. In this regard, a male farmer who participated in the FGDs stated:

DAs used to tell us what we know so far. They focused more on theory. Also, the topics are always the same: Frankly, I have been trained on crop production, NRM, and Animal Development for the last five years. In my view, crops are different: maize, teff, wheat, barley. They have different characteristics. There are different varieties for each. We have different priorities; I prefer to plant teff; while my colleagues prefer maize, or wheat. So, DAs do need to design a training that can address such issues and our priorities.

Besides, work place learning theory (Long, et al., 2000) informed us that farmer characteristics such as: age, sex, ethnicity [language], education (illiterate and literate), ability, and motivation should be considered during a training programme delivery. The current practice in the study context does not reveal such evidences. The criteria to bring farmers together to a training session is only their farming activity. Their sex, age, level of education, cognitive ability, and motivational differences are not taken into account. Still, a training design that addresses: a) job characteristics; for instance, planting, weeding, harvesting, spraying pesticides and herbicides; b) farm characteristics; such as, small plot of land, type of crop, soil characteristics and sensitivities; and, c) socio-political and economic environment issues; like, price of inputs/outputs, policy issues on credit access, land use and soil fertility are missed. It is to be noted that the public agricultural extension training services is designed to increase knowledge and skills of farmers which is based on the assumption that education [training] improves production performance and maximize household food security (cf. Huffman,2001; Fane, 1975). Unfortunately, the educational services provided to farmers are found poorly organized and are not provided based on theoretical foundations of adult teaching and learning principles which is mainly attributed to the capability of DAs (Tarekegne, et al., 2017). The inequality between men and women in the training services offered by DAs is still going on with its potential to contribute to lower

agricultural productivity, household food insecurity and prevalence of rural poverty (IFAD, 2009).

6. Conclusion

It is learnt that women who are widowed and divorced are participating in the training services rendered by DAs whilst other women farmers who are husbanded and bachelorettes are ignored. To enhance agricultural productivity, ensure household food security, and reduce rural poverty, the training provided to smallholder farmers should be all inclusive. We learnt that training is provided for the sake of providing reports for higher public officials. Instead, it should be designed scientifically to enable smallholders be able to acquire knowledge and skills and achieve positive attitudinal change so that they can improve their farming performance (productivity) in terms of yield/hectare. Illiterate women farmers should be able to attend adult education and achieve literacy since education plays significant role to minimize factors that hinder women farmers' participation in the rural development practices. We concluded that the numerous rhetorical expressions on empowering women and mainstreaming gender in the public sectors are non-existent in practice; for instance, in this case, in the agricultural extension training/advising services provided by DAs which is biased towards male farmers largely.

7. Implication for Theory, Policy and Practice

The study will give a new lease of life to adult learning theory (or adult education), theories of feedback and work-place learning, gender development and mainstreaming in the rural development process of Ethiopia. It will initiate policy makers to review the agriculture extension training/advising services from the view of empowering women farmers of all social status and monitor their commitment entered into Maputo Declaration (10-12 July, 2003) and to CAAD (Union, 2003). It will also help district/local level agricultural extension service implementers to consider those factors affecting women farmers' participations.

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Book Review

Collapse: How Societies Choose to Fail or Succeed by Jared Diamond, New York: Viking, 2004, 526 pages

Jared Diamond is a renowned geographer and biologist who has published many books and journal articles. One of his books titled, *Collapse: How Societies Choose to Fail or Succeed* is an informative read for those interested in the formation and evolution of human societies and civilizations. The archaeological sources, which the author used to substantiate his explanations and arguments on how ancient civilizations flourished and declined, are intriguing. The author examines cases from each continent of the world, to show how ancient and modern civilizations succeed and fail in Africa, Europe, Australia, Asia and America. Structuring the content as a series of question and answer, the author impressively brings together complexity and clarity and makes the entire experience a joy to the reader. He begins his writing by raising a grand question, *How Societies Choose to Fail or Succeed,* and continues another question: why do some societies make a disastrous decision? The book has four parts, divided into sixteen chapters which are coherently organized.

The first two parts of the book mainly deal with cases in ancient societies, their success and failure in their civilization. The author identifies factors, which determine the success and failure of the societies in their civilization. These are, among other things, environmental degradation, climate change, population growth, bad tradition (culture), hostile neighbors, and unfriendly trade partners.

As exemplars of failed civilizations, the author examines the cases of Montana, Easter Islands, Henderson Island and Pitcairn Island, Anasazi, Maya, Viking and Norse Greenland (p. 25-276). According to the author, ancient peoples in these regions founded well-organized civilizations. However, these civilizations collapsed because of the aforementioned factors. For instance, in Ester Islands different peoples were competing to build monuments, palaces and houses for residence or prestige. From the year 1400 to 1600 AD, forests in the Island were nearly cleared. This led to the collapse of Easter Islands (p. 107).

In line with failure stories, the author argues that the collapse of one society's civilization may a cause for the collapse of another society's civilization. He presents the cases of Mangareva, Pitcairn and Henderson islanders. These islanders had reciprocal relations for many years. They exchanged their products through trade and marriage gifts. However,

because of massive deforestation and soil erosion Mangareva was unable to feed its large population. This brought internal and regional chaos. The collapse of Mangareva brought the decline of Pitcairn and Henderson.

Interestingly, Jared also shows that collapse can also occur in the most developed societies. The Anasazi and Maya are good examples. The Anasazi, though they had no writing system had achieved astonishing civilization which flourished about 600 AD in southwest America (p.143). They erected large stone buildings without the influence of neighboring civilizations, but they were dependent on imported food from Mexico. Thus, lack of imported goods, deforestation, lack of rainfall and fighting with each other were some of the factors for the disappearance of the Anasazi civilization.

The Maya had their own writing system and were known for their pottery, basket making and building civilization. They mainly grew corn and beans for food. They used different mechanisms to conserve the ecology including tunneled depression construction to collect rainwater. The Maya civilization collapsed because of recurring occurrence of drought, bad neighbors, and dysfunctional government. Another important point that the author highlights is the significance of food security for military strength and the survival of a society. The Maya and Aztecs corn agriculture were not sufficient to support its people and soldiers. On the other hand, the Maori, the earliest settler in New Zealand, transformed their economy when the Europeans introduced potato in 1815. They began to produce huge amount of potato, which enabled them to feed many soldiers. As a result, they successfully occupied many territories (p. 165). Similarly, the Inut and the Norse people shared the Greenland Island for living. However, the traditional norms of the Norse, for instance, a taboo that is against eating fish, contributed to their collapse whereas that of the Inut which promoted the preservation of the environment contributed for the survival of their civilization (p. 230).

There were also societies who were able to successfully adjust or adapt to their civilization. Some of these were found in New Guinea, Japan, Tikopia, and Tokugawa (p. 277-308). People in these regions have faced a high rate of population growth and scarcity of resources such as land and wood. This brought deforestation and soil erosion (p. 429). The people devised bottom-up and top-down approach to preserve the ecology. For instance, Tikopia islanders eliminated pigs, even though they were the sole large domestic animals and a symbol of social status (p. 522-524). The New Guinea Highland adopted crop rotation

strategies to keep the fertility of the soil. Other methods used to check population growth included contraception, infanticide, abortion, suicide and starvation (p. 285-300).

In the third part of the book, Diamond analyses modern societies, the cases of Rwanda, Dominican Republic and Haiti, Lurching Giant in China, and Australia. He explains that these modern societies are also failing as well. The Rwanda case was one of the most shocking happenings of recent times Colonialism, high population growth, extreme deforestation, scarce resources and dysfunctional government led to genocide (p. 311).

On the other hand, Haitian and Dominican people live on the same island, Hispaniola but have different stories. The Haitian has received less amount of rainfall because of the barrier of high mountains blocking rains from the east than the Dominican. In Haiti the topography and the soil is not conducive to agriculture. However, Haiti developed a rich agricultural economy ahead of the Dominican Republic. The paradox is that Haiti's burst of agricultural wealth came at the expense of its environmental capital of forest and soil. Gradually, however, Haiti became one of the poorest countries in the word. The reason for this, according to the author, was not only the environment degradation but their histories, attitudes, self-defined identity, institutions and difference in leadership (p.329). Another case the author raises is the environmental problems in China. Air pollution, overgrazing and cropland loss are some of the acute problems in China. The author also discusses the situation in Australia. He mentions Australia has faced several problems, including scarcity of water, land degradation and remoteness (p. 378).

The fourth part of the book deals with the practical lesson to be drawn from these stories and where we might look for solutions for the problem. He grapples with the question of why do some societies make a disastrous decision and offers four possible explanations First, a society may fail to anticipate a problem before it happens. Second, a society may fail to anticipate when the problem happens. Third, a society may fail to recognize the problem after it is perceived. Forth a society may fail when attempting to solve it.

In general, the book provides empirical examples and historical lessons that can help us to recognize the grave danger our world faces at present but also how to care for the environment. From the collapse of Montana to modern day Australia and China, and to events as recent as in Syria and Iraq, Diamond in this book not only reminds us to acknowledge the ever-present danger of collapse but also challenges us to remain vigilant.

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Book Review

Silences in African History: Between the Syndromes of Discovery and Abolition. By Jacques Depelchin. Dar es Salaam: Mbuki Na Nyoto Publishers. Distributed by African Books Collective, Oxford, UK, 2005, 265 pages.

Recent developments in historical methodology have revealed that to solely depend on empirical evidences and to keep aloof from other fields of studies could not make any sense if one wants to disclose the courses of events in such a way that the things that will be considered would come nearer to the 'truth.' That is why some scholars of history have given emphasis to the need to approach historical developments through interdisciplinary models. The proponents of such models have argued that other social science fields of studies would play a crucial role while scholars are embarking on reconstructing the past. In this respect the author draws attention, besides other social science fields of studies, to literary works like novels and poetry as essential instruments with which silences could possibly be unveiled (193-194). Of particular importance is his firm conviction on the need to acknowledge silences as facts and using them systematically in approaching the history of Africa.

This book, which gives us a new reorientation towards approaching the history of Africa, has many strong sides. The major strength of the book lies on its ability to reveal the instruments imposed by western and American world capitalist system by which important historical developments have been downplayed. With his sharp thought and sarcastic pen, he depicts the political, ideological, economic, academic, and ethical instruments of erasures which primarily geared towards their advantage, fog the direct connection between slavery and Atlantic slavery and colonial plunder with the development of capitalism and the capitalist system. Not only it reveals the erasure of the truth but also it significantly challenges the ivory tower approach of Anglo-American and to some extent western historiography. Regarding those Africanist historians who have been instrumental of erasure of historical knowledge, he said "swim against the current" instead of becoming mere supporters of those who coined paradigmic silences (1). He portrays that the winners' history shall not dictate the rules along which historical research and methods will be developed in Africa (31-33). In connection with the paradigms of denial and affirmation of the African past the book clearly shows us how denial of African history before 1960 and reorganization of its past after 1960 is indeed denial when recognition is accompanied with paradigmic silence (12). With regard to method, he came up with the notion of procuring historical authorities out of silence. This

is not, however, a shift from reading from books and archives to the sole use of silence, but recognition of silence as facts which have not been so far accorded the status of historical evidence (13). Depelchin argues that systematic search for the latent is essential so as to balance the story of the victors (22). His premise is the hunt for empirical facts alone is insufficient to figure out developments in their true color (28). Another concept that demonstrates the bravery of this Congolese author is genocide. In this regard he argues that concepts like the genocide, crime against humanity, and holocaust are not the repercussions of the Second World War. For him crime against humanity dates back to the times of slavery and most importantly with the times of the Atlantic slavery. This coupled with the policy of apartheid, the destruction and humiliation in the Belgian Congo, the assault in Rwanda and other erasures of genocidal magnitude were the things that keep the flames inside Depelchin with which he ravaged the center of colonial and capitalist knowledge production. Laconically put, he has got wit and courage to tell Africanist scholars the need to stick to the ethics of historical knowledge production (25-30). The reproduction of historical knowledge requires, among others, as the Chinese historiography tells us, life sacrifices. This is what Depelchin wants to instruct us by taking the self-suicidal endeavor of Patrice Lumumba, an immortal figure who defied the altruistic view of colonial or capital paradigm (75-76). He vehemently told them as he would never forget the multifarious traumas that slavery and colonial rule had brought to the Congolese and thus would never forgive. "It is still too early to forget" were his words. For which reason he was silenced shortly after Congo has achieved her independence in an obscured manner. With his death, substantial amount of facts was silenced (81-87).

His discussion of colonial anthropology and economics brings us to see how the destruction of the "inferior" ones during the Atlantic slavery could not be tabulated and could not be compensated in terms of monetary and financial terms as was the case with the holocaust of the Jews. Thus, it violates the tenets of comparative advantage or positive balance sheet, baptized and thus being saved in the life after death (128), and teaching the virtues of time and work with which the colonial paradigm aspired to blur reality by stripping of their historical context (109-121). Under the guise of improving Africans' future, Deplechin tells us, institutions like the World Bank and the International Monetary Fund silence the very foundations of the capitalist system (slavery and colonial rule). In short, he defines the above institutions as centers of slow death (27).

Though unfair to cap the strong sides of the book this way, it is essential to point out the contrast between Acheb's *Things Fall Apart* and Armah's *The Healers*. Achebe's approach which corresponds with the colonial discourse met modest criticism while Armah's vision of the world of Africa takes central concern for him. The castigation of the author rests on Achebe and on the Africanist historians who, in the eyes of the author, were agents of the destruction of the world of Africa who shared the European vision of society. But in the midst of despair, Depelchin tells us, there are hopes in that healing will be possible from within, but shall not be entrusted to those Africanists and Europeans (160-171).

Simply not to elevate this book to the level of blameless status, I would like to point out three things as weaknesses. The first one is associated with grammar and choice of words. The book is not written with simple and plain terms. This is perhaps the major weakness as it poses, at least for the novice, an impediment in reading and comprehending what he intends to inculcate. Secondly there are unnecessary redundancies which remain to be boring to its readers. The other shortcoming of the book is that it fails to demonstrate those silences which could be used as historical authorities. This is presumably owing to his preoccupation with the instruments of silence.

In his attempt to analyze and examine the influence of capitalism on the continent of Africa, Depelchin employs relevant economic, ideological, ethical, and political theories. The major economic theories with which he tries to unveil silence in African history are the theory of Balance Sheet or Cost Benefit Analysis or Comparative Advantage. In this regard he powerfully and elegantly depicted how the traumatic experiences that Africans met, ever since the times of slavery to colonialism and then to global market, was far destructive than the so-called benefits that the Africans have got from such evils. For him, such destruction, be it in the times of slavery, colonialism or global market could not be even compensated in terms of monetary and financial terms. Above all he asserted that the economic, political, and cultural success of the capitalist system had its root in the Atlantic slavery and colonial plunder. So, dissociating the two will never make any sense if one is to tell about the "true'' relationships of historical developments (55-63). The capitalist system has used several ethical and moral instruments of silence which Depelchin exposes it quite convincingly. In this connection we find the theory of 'Forgive and Forget' which cost the lives of many genuine Africans including Patrice Lumumba. Another interesting theoretical framework is the Altruistic Approach which claims that what had happened to Africa during the Atlantic

slavery and colonial conquest was to the advantage of its people as Jesus Christ came and was crucified to redeem the peoples of the world from their sins through His blood while the objective had been purely economic. The abolitionist theory which was considered as a philanthropic act is also used which Depelchin saves it from being downplayed by the abolitionists when he said abolitionist theory is all to erase the link between slavery and the Atlantic slave trade with the expanding world capitalist system (63). The concept of genocide is the other theoretical frameworks with which Depelchin tries to unveil silence. He has the conviction that concepts like genocide and crime against humanity could not be oversimplified by linking its start only with the Second World War. According to him such concepts have their roots in the Atlantic slavery and in colonial conquest. He castigates those who were reluctant to pronounce the genocide in Rwanda as crime against humanity for it interpreted as crisis in Rwanda (*Ibid*, 25-35). Politically we have the theory of domination and paternalism that tends to associate economic development and social betterment with colonial rule. Depelchin makes clear that the forces which had profited from slavery, colonial rule and apartheid sought to maintain their control by silencing the history of the victims. For him the history of the victims should not be written by exotic dominant models (56).

In terms of method the title of the book is self-explanatory in that Depelchin is very much concerned in how to systematically use silences as historical facts in the reproduction of historical knowledge without necessarily denying the importance of empirical data. Nor did he hides the pains with making silences speak particularly paradigmatic silences (10-11). Again, he uses a galaxy of secondary literature, approximately 417 books having direct bearing on the issue under consideration. In addition to using such a large array of secondary literature he has used funeral orations (231); made discussions with scholars (227); and has critically consulted novels to support his argument. Achebe's *Things Fall Apart* and Armah's *The Healers* are the most important in this connection (159-164). Depelchin gives a good deal of rooms for oral poetry as essential sources of historical knowledge production. In this regard, he tries to analyze the importance of oral poetry in terms of their role among the Yoruba and Somali peoples (183-194). Besides, he consulted letters (175), reviews and the works of missionaries (174). It is also the conviction of Depelchin that the production and reproduction of historical knowledge should not be left only to historians. As a result he calls for an interdisciplinary approach. He believes that other social science fields of studies like anthropology, economics, ethics and moral educations and law; literary works like poetry, as described in the preceding pages, can play a great role in unveiling silence.

The writer gives us an immense contribution in widening the horizon of our historical knowledge pertaining to the history of Africa. It plays an eye-opening role for it demonstrated vividly the intertwined nature of the current capitalist world system with such evils as slavery, Atlantic slavery, colonialism, apartheid, genocide, and global market. He adds to our knowledge of the political, economic, moral, ethical, and academic instruments with which western capitalism distort the "truth" about Africa's past, present and future. A thorough reading of this book brings one to better realize the human causality that happened during the Atlantic slavery, colonial rule, apartheid, and the various massacres and killings as unregistered and unrecognized genocides and thus help us know the historical roots of the concept of crime against humanity as opposed to the western notion that links its beginning with the Second World War (30-35). As students of history it is required to come closer to the "truth." This is what Depelchin has done it with his elegant and powerful discussion of silence in African history. He vehemently exposed those pro-western and Africanist historians who distance themselves from the historical reality. This is a great lesson for us that we should acknowledge. With his writing, Depelcin brings us nearer to those institutions with which capitalism brings traumas on the peoples of Africa and gives us the opportunity to see closely what evils the World Bank and IMF have been doing on Africa (129-137). The chameleon like gesture of capitalism is also forced to stand naked. The change of its nature and gesture from one historical period to another is eloquently traced (170). This is another great lesson for the reader and above all for students of history. The methodological instructions that he came up with this work is also an interesting insight into our previous knowledge in this connection. The systematic use of a new sort of historical source, i.e., silence, adds to our mere dependence on archival, oral, and secondary sources. Silences as sources of information have not been accorded the status of facts hitherto. But now onwards they do. This is also a wonderful lesson that we get from this book. Our reorientation towards using other fields of studies like the other social science disciplines and literature in the form of poetry is reinforced by this prolific writer. Morally the writer advices us to show no fear and favor to the forces of reactions, even at the cost of our lives, to stick to the 'truth," to boldly castigate those who, albeit they are our own stock, distort, muffle, and blur the correct link between historical developments, and if possible to try to unveil silences with which we can demolish the ivory towers. No less is the writer's role in making clear the socio-economic, political, ideological, ethical, moral and academic approaches that are essential to discuss historical developments; their relations to one another through the course of time and the impacts they have incurred on either side. In this regard, we have got the chance to know

the theories of positive balance sheet or comparative advantage, paternalism, altruistic view, and the policy of forget-and-forgive. Of particular importance in this respect is the lesson we have got as the traumatic experiences of the African peoples during the Atlantic slavery and colonial rule, as stated earlier, could not be approached in terms of monetary and financial terms, and the need to not forgetting and forgiving evils of unprecedented magnitude such as slavery, apartheid, colonial rule and genocide. That is why Patrice Lumumba said "It is too early to forget…" and was killed in an obscured manner (85-87). That is why Mandela said "It is good to forgive, but we will never forget" and was awarded the Noble Peace prize. So, the writer is meant to alert us identify developments, past and present, in their true colors.

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