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Socio-Economic Impacts, and Factors Affecting Adoption of Watershed Management Practices Between the Treated andUntreated Micro-Watersheds in the Chirachasub-Watershed of Ethiopia

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ABSTRACT

Present study concerned with the impact of watershed management practices on the peoples' life and environs, and to know the factors responsible for positive and negative impacts. The study was conducted in the Chiracha sub watershed of Kuyu district of North Shoa Zone of the Oromia regional State of Ethiopia. Out of 11 micro watersheds of Chiracha, two similar micro watersheds (one treated - Dima Bite, and one untreated-Finchawa) were purposively selected, and change was studied through the comparison between the two.Watershed management practice was taken as the basic operational unit to rehabilitate the degraded land and improve agricultural productivity of land in Ethiopia. This study was designed to assessfarmers' perception on impact of watershed management practices and identify the factors that affect the adoption of soil and water conservation practices based on comparative analysis between Dima Bite (treated) and Finchawa (untreated) micro-watersheds. Data were collected from (n=123) sample respondents using probability proportional to sample size method. Descriptive and inferential statistics and binary logistic regression model were used to analyze the dataWatershed management practices have bio-physical, socio-economical and environmental impacts. The results indicated that due to watershed management practices the availability of water, income per household from crop production by 26%, livestock productivity, employment opportunities, environmental quality were increased. It also reduced runoff, soil loss, and land degradations. The logistic regression model predicted four factors influencing the adoption of soil and water conservation including farm size, farming experience, the distance from home to farm plot and slope of land in the two micro-watersheds.Therefore, intervention of watershed management practices, and awareness of local community need to be encouraged to ensure sustainable watershed development.

1. Introduction

Ethiopia- well known as the water tower of East Africa, and the cradle of humanity is one of the fast-growing countries of Africa. Ethiopia is one of the most well endowed countries in sub-Saharan Africa in terms of natural resources and valuable diversity in the production environment (Gete*et al*., 2006).The country has a huge potential natural resources which includes 12 river basins with an annual runoff volume of 122 billion m^3 of surface water, 3.7 million hectare of potentially irrigable land that can be used to improve agricultural production and productivity and 2.6 up to 6.5 billion m^3 of ground water potential, which makes an average of 1575 m^3 of physically available water per person per year, a relatively large volume and the distribution and availability of water is erratic both in space and time (MoWR, 2002; Seleshi *et al.*, 2007). Despite these potential resources base, agricultural production is lowest in some parts of the country attributed to unsustainable environmental degradation mainly reflected in the form of erosion and loss of soil fertility (Demel *et al*., 2004).

Land degradation is a serious challenge to Ethiopia,and like sub-Saharan Africa (SSA), here too, is largely an outcome of the existing agricultural production system, which is a ‘resource-poor’ agriculture characterized by uncertain rainfall, low inherent land productivity, lack of capital, inadequate support services and poverty (Mekuria, 2005). Ethiopia faces land degradation as one of its major environmental problems(Abebe *et al*., 2013) and land degradation is occurring at an alarming rate in Ethiopia (Temesgen, 2012), which causes for important social and economic problems (Hurni *et al*., 2005; Menale *et al.*, 2007; Moges and Holden, 2008; Bewket and Sterk, 2009). Ethiopian highlands which contribute more than 56%, are seriously degraded and slowly but continuously moving towards becoming unsuitable to cultivation (Tesfaye & Tripathi, 2015). Deficiency of soil nutrients and increasing deterioration of soil health is a common phenomenonthroughout Ethiopia, especially the densely populated highlands, affecting the overall agriculture production in many ways (Kassa G. et al. 2019).The tree cover in Ethiopia continues to dwindle every year. The major reason for this resource shrinkage is the increasingly intensive use of land for crop and livestock production (Azene, 2007b).

Watershed management practices have been promoted in many countries as a suitable strategy for improving productivity and sustainable intensification of agriculture **(**Azene, 2007a). Watershed management is the integrated use of land, vegetation, and water in a geographically discrete drainage area for the benefit of its residents, with the objective of protecting or conserving the hydrologic services the watershed provides and reducing or avoiding negative downstream or groundwater impacts (Darghouth *et al*., 2008). Land degradation is a common environmental problem in Ethiopia which decreases the productivity of agricultural lands and causes loss of vegetation cover. To overcome these problems the Ethiopian government has been implementing watershed management mainly through public campaign to rehabilitate the degraded lands. Considering the accelerating rate of degradation in highlands of Ethiopia the soil and water conservation program started almost 50 years before but the target achieved were not much encouraging (Tasfaye& Tripathi, 2015), the prime cause reported as the failing in involving the stakeholders into the program (Daniel Jaleta, 2020).However, its effects have not been evaluated in many micro-watersheds of the country (Kebede, 2015). Therefore, this study was carried out to assess the impact of WSMP on crop and livestock production and the perception of farmers,andidentifythe factors that affecting watershed management practices in the micro-watersheds.

Likewise, the similar problems were observed in theChiracha sub-watershedfor the last three decades. Land degradation in the study area has caused low crop and animal production, tremendous disaster, trigger food insecurity, migration of the community to nearby town, loss of biodiversity and change in the physical structure of the soil. Keeping all these factors in mind extensive watershed management program was launched in selected micro watersheds. Present study attempts to study the impacts of watershed activities on treated microwatershed and its comparison with the untreated watersheds of within the Chiracha sub watershed.

2. Materials and Methods

2.1. Description of the study area

Chiracha sub-watershed is found in Kuyu district of North Shoa Zone of the Oromia National Regional State. Kuyu district is located 156 kms North of Addis Ababa, capital city of Ethiopia within $9^o35'$-$9^o49'$N latitude and $38^o03'$-$38^o31'$E longitude, geographically. Chiracha sub-watershed is situated 10 km to the south-east direction from Gerba Guracha town. Geographically, it is located between 9^0 38’ 50”- 9^0 45’ 75” N latitude and 38^0 22’ 23”- 38^0 29’ 22”E longitude. Dima Bite and Finchawa micro-watersheds are found in Chiracha sub-watershed in Kuyu district (Figure 1).

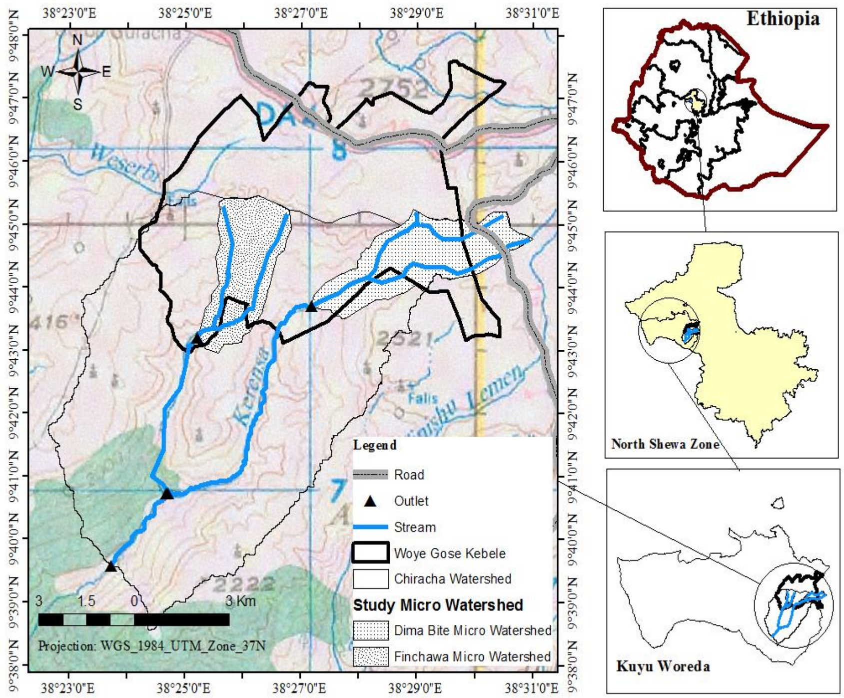

Figure 1. *Map of the study area*

Chiracha sub-watershed has 11 micro-watersheds which cover 6 kebeles. The survey was conducted on two micro-watersheds in Chiracha namely, Dima Bite (treated for five years) and Finchawa (untreated) micro-watersheds. They were found in Woye Gose kebele and characterized by flat, undulating, rolling, steep, hilly and mountainous topography. The altitude of the two micro-watersheds ranges from 1500 to 2500 meters above sea level (m.a.s.l) (KWAO, 2015), depicting similar topography, slope and aspects. The total population in the 'Kuyu' district is 152,366 of which 75,523 are males and 76,843 are females. Among the total population 14,439 are males and 14,797 are females with a total 29,236 population living in urban area. Whereas 61,084 males and 62,046 females measuring a total of 123,130 population are living in rural area (CSA, 2013). Chiracha sub-watershed has 16606 total populations and 3096 total number of households.

2.2 Survey Data Collection

Descriptive research design with survey method was followed to compare the impact of watershed management practices on woody species composition, farmers' perception and adoption. Booth qualitative and quantitative information from both primary sources and secondary sources were collected. Tools used were house hold survey (structured with close ended questions), Key informants interview, and focus group discussions (semi structured with open ended questions), and field observation using check list. Purposive as well as random sampling techniques were used.

Dima Bite from treated and Finchawa from untreated micro-watersheds were purposively selected from Chiracha sub-watershed by considering their location, agro-ecology and socio-economic similarity, and having similar intervention for development. The two micro-watersheds have similar topographic features, altitude, rain fall, soil type and temperature because they were located in one sub watershed and have common outlet. Total sample sizes of 123 households were selected by using simple random sampling technique from the two micro-watersheds (Table1). Using the probability proportional of sampling size technique, the sample sizes from two micro-watersheds were calculated. The required sample size was determined using a simplified formula provided by Cochran (1977),as follows.

n= (2.1)

Where, n= sample size

N= total population of households in both sites

Z= confidence interval (1.96)

d= margin of error

p= proportion of population (0.5)

q= 1- p

Assumption: d= 0.05 and q= 0.5

Table 1. *Distribution of sample households by the two micro-watersheds*

Micro-watershed	Total number of HH	% proportionate	Sample size of HH
Dima Bite (treated)	274	56	69
Finchawa (untreated)	211	44	54
Total	485	100	123

In addition, a total of 15 key informants were selected from the two micro-watersheds and four focus group discussions were held which contain 10-15 persons for each micro-watershed. Discussions were held about the present and past watershed management practices, land degradation, woody species cover and community participation, perception and adoption of the management in the two micro-watersheds were assessed by comparing the two micro-watersheds.

2.3. Data analysis

Data which was collected from both primary and secondary sources were analyzed, summarized and presented through quantitative and qualitative method. For quantitative data analysis both descriptive and inferential statistics were used. Descriptive statistics includes percentage, frequency, mean, standard deviation, maximum, minimum and cross-tabulation. Inferential statistical analysis (continuous data) was analyzed through one way ANOVA (Analysis of Variance) and t-test, while, categorical data was analyzed using chi-square ($\chi 2$) test. Binary logistic regression econometric model was used for the strength of relationship between independent and dependent variables influencing the adoption of soil and water conservation practices. Finally all the collected data were compiled and analyzed by using SPSS computer software version 20 and STATA version 11 software. Then the collected data were analyzed, interpreted, and presented in tables and figures.

2.4.1. Econometric model specification

In adoption studies, the response to a question such as whether farmers adopt to a selected technology could be Yes or No, is a typical case of dichotomous variable. . For this study the binary logistic distribution function (logit) model was selected. The logistic function was used because it represents a close approximation to the cumulative normal distribution and is simpler to work with.

The dependent variable of the model has dichotomous nature representing the observed status of the farmers' adoption to selected SWC practices. For this study the dependent variables were adoptions and non-adoptions of the stone and soil bunds. The main reason behind for the selection of these two types of SWC structures were because of their wide introduced into the study area. In this case, 1 = Yes if households were adopters to either soil bunds, or stone bunds or both on their land holding and 0 = No if households were non-adopters to none of the soil and water conservation structures (neither soil bunds nor stone bunds) on their land holding.

The independent variables were expected to influence farmer's practices to adopt or not to adopt the selected SWC practices. Some of the independent variables were; age, sex, distance to market, plot distance , family size, perception on land degradation, educational level, farm size, farm experience and slope of the land which affect the adoption of farmers towards the selected SWC practices either positively or negatively depending on the output results.Following Gujarati (1995) and Hosmer and Lemeshow (1989) the logistic distribution function for the adoption of selected SWC practices can be specified as:

(2.2)

Where Pi is a probability of adopting a given practice by i^{th} household head. The odds to be used can be defined as the ratio of the probability that a farmer adopts the practice $p_i$to the probability that he or she was not 1- P_i.

(2.3)

(2.4)

(2.5)

Taking the natural logarithm of the odds ratio of equation (2.5) was result in what is known as the logit model as indicated below.

(2.6)

Zi = is a function of an explanatory variables (x)

B_o =is an intercept

Xi = is vector of relevant household characteristics

If the disturbance term Ui is taken in to account the logit model becomes

(2.7)

3. Results and Discussion

3.1. Impacts of Watershed Management Practices

Impact on households' incomes

Watershed management increased agricultural production and income of the households, while protecting the sustainability and ecological function of the environments. Mixed farming system which involves crop production and animal husbandry was adopted by farmers in the two micro-watersheds. The main sources of household incomes of respondents were from crop production, animal production, natural resource use, employed earning by salary, vegetable production, Safetynet program and from off-farm activities (Table 2). The major sources of household incomes were from crop production (43.5%) in Dima Bite and (51.85%) in Finchawa followed by animal production (Table 2). Watershed management had positive impact on income sources.

Table 2. *Distribution of sample households in terms of income sources*

	Dima Bite		Finchawa	
Income source	Frequency	%	Frequency	%
Crop production	30	43.5	28	51.85
Animal Production	18	26.1	12	22.2
Natural resource	2	2.9	8	14.8
Employed earning	2	2.9	0	0
Vegetable production	15	21.7	5	9.3
Safety-net program	2	2.9	0	0
Off-farm activities	0	0	1	1.85
Total	69	100	54	100

The survey result showed that, household incomes of some respondents were improved. The result indicated that (74%) and (29.6%) of respondents' household incomes were improved and (26%) and (70.4%) of respondents' household incomes were not improved in Dima Bite and Finchawa, respectively (Table 3). The greater percent of income improvement in Dima Bite was due to capacitating the watershed management inhabitants by introducing alternative technologies like provision of improved crop and vegetable varieties, introduction of irrigation schemes, improved farming activities and adoption of SWC practices, which in turn increased fertility of soil and reduce soil erosion as compared to Finchawa. The study was supported by the finding of Tesfaye (2011) in Lenche Dima, Tsegur Eyesus and Dijjil

watershed indicated that watershed management practices improve the household incomes at different level.
Different reasons were replied by the watershed respondents that household incomes were not improved (Table 3). The main reason that most of the household incomes were not improved for the two micro-watersheds were due to lack of SWC practices, poor quality input (e.g. seed, fertilizer), soil fertility problem and lack of water resources. The survey result showed that (67%) of the respondents in Dima Bite replied as soil fertility problems and (47.4%) of respondent in Finchawa replied as lack of SWC practices (Table 3). But, in Finchawa there were no technological intervention as compared to Dima Bite.
Table 3. *Status and factors affecting household incomes in Dima Bite and Finchawa*

Indicator	Dima Bite		Finchawa	
Improved HH incomes	Frequency	%	Frequency	%
Yes	51	74	16	29.6
No	18	26	38	70.4
Total	69	100	54	100
Reason for not improved	Frequency	%	Frequency	%
Lack of SWC practices	2	11.1	18	47.4
Poor quality input (e.g seed, fertilizer)	4	22.2	4	10.5
Soil fertility problem	12	67	3	7.9
Lack of water availability	0	0	13	34.2
Total	18	100	38	100

Impact on crop production

It has been observed that crop production was the most important source of household incomes directly or indirectly in the two micro-watersheds. The main crop production types in the two micro-watersheds were cereals crops such as *teff* (*Eragrostis tef)*, barely (*Hordeum vulgare)*, wheat (*Triticum vulgare*), maize (*Zea mays*), sorghum (*Sorghum bicolor*), beans (*Vicia faba*), peans (*Pisum sativum*), niger seed (*Guizotia abyssinica)* and vegetable such as potato (*Solanum tuberosum*), onion (*Allium cepa*), garlic (*Allium sativum*), carrot(*Daucus carota var. sativa*), tomato (*Solanum lycopersicum*) and cabbage (*B. oleracea var capitata*). The crops produced in the two micro-watersheds were the same due to come from similar agro-ecological zone. The major crops grown in the two micro-watersheds were *Teff* followed by Wheat.

Likewise the total income per household from crop production in Dima Bite was 43382.1 (63%) Birr per household per year and in Finchawa it was 25116 (37%) Birr per household per year (Table 4). The cost was calculated based on current market prices. The great differences between the two micro-watersheds were accounted as 18266.1 (26%) Birr per household per year. This indicated that watershed management intervention increased crop production and income in Dima Bite as compared to Finchawa. This result was supported by the finding of Gerbe-Mariam *et al*. (2015b) stated that watershed management has positive and significant impact on major crops due to increase in soil fertility in treated sub-watersheds as compared to untreated sub-watersheds. Even though farmers grow a number of crops in Finchawa, but they obtained very low yield due to lack of SWC practices which in turn increased soil erosion problems. But in Dima Bite watershed management interventions changed the attitude of community towards the construction of different soil and stone bunds which in turn reduced soil erosion and increased crop yields. This result was supported by the finding of Abay (2011) whereby yield has increased by (22%) on some farms within one year of bund construction and by greater than (50%) after 3 years with similar farming practices. Tesfaye (2011) and Meaza (2015) which depicted that crop production and SWC practices have positive relationship.

Table 4. *Mean crop production and income per households in Dima Bite and Finchawa*

	Dima Bite		Finchawa	
Types of crop	Production (Qt /year)	Income per household/year (in Birr)	Production (Qt / year)	Income per household/year (in Birr)
Teff	12	15900	7.2	9540
Wheat	8.2	6560	5	4000
Barley	5.7	4560	3.5	2800
Maize	3.6	1800	2	1000
Sorghum	2.7	2295	1.5	1275
Beans and peans	4.5	6750	2.5	3750
Niger seed	0.5	1000	0.3	600
Vegetable	6.3	4517.1	3	2151
Total	43.5	43382.1	25	25116

Impact on livestock

In the two micro-watersheds it has been observed that livestock populations was an integral part of the farming systems and considered to be an asset that could be used either in the production process, or be exchanged for cash or other production assets. In the two micro-watersheds cattle, sheep, goats, poultry, horse and donkey has been raised for both source of food and commercial purposes. Households' livestock ownership is measured by the average amount of Tropical Livestock Unit (TLU). The total livestock number in Dima Bite was 295.9 TLU and 458.9 TLU in Finchawa for sampled households (Table 5). This result indicated that intervention of watershed management practice decreased number of livestock in Dima Bite by 163 TLU from the number of livestock registered in Finchawa. Especially the radical change was observed on goat and sheep numbers due to completely protected from grazing land which was under area closure. Because they reduce the seedling survival of plant species and fertility of top soil which cause land degradation problems.

The contributions of watershed management were promoted less livestock holding but emphasis on the quality and productivity of the livestock. Similar the management also promoted the cut and carry practice of feeding system which discourages the livestock mobility and number. This is done to limit dependence of livestock on grazing land and it further facilitated the environmental rehabilitation. From this view it could be inferred that watershed management technology adoptions geared to hold less livestock so that the quality could be assured and productivity of livestock was increased. The study was in line with the finding of Sebhatu (2010), Arya*et al*. (2011)and Meaza (2015) the number and size of livestock units per households were found to be higher in untreated watershed than in treated watershed because of closure to grazing areas as a result of social fencingadopted by hill resource managementsociety.

From FGD and key informants in Dima Bite, it could be concluded that watershed management intervention decreased livestock number and contribute to livestock management by providing fodder. The undersigned bodies pointed out that livestock size and type were decreased due to limitation of free grazing land. The cut and carry system needed human labour and due to this challenge some farmers sold their livestock at low price and gave their farm land for rent. But the FGD and key informants in Finchawa revealed that the number of livestock was high and did not balance with the carrying capacity of the land thereby increase the degradation of grazing land. This result was similar with the finding of Engdawork and Hans-Rudolf (2015) shortages of grazing land, inadequate feed supply, and poor quality of grass were the most often mentioned indicators for the deterioration of grazing land. The overall characteristics of livestock feed sources, grazing land condition and number of livestock triggered land degradation.

Table 5.*Distribution of livestock production by respondents*

	Dima Bite			Finchawa		
Livestock population	No of Livestock	TLU*	Total TLU	No of Livestock	TLU*	Total TLU
Cattle	221	1	221	342	1	342
Sheep	242	0.13	31.5	314	0.13	40.8
Goat	120	0.13	15.6	277	0.13	36
Donkey	33	0.7	23	46	0.7	32.2
Horse	0	1.1	0	2	1.1	2.2
Poultry	475	0.01	4.8	571	0.01	5.7

Total	1091	295.9	1552	458.9

*Conversion factor used in to TLU was: cattle = 1, sheep and goats = 0.13, horse = 1.1, donkey = 0.7, poultry = 0.01 (adapted from) (Storck *et al*., 1991).

3.2. Econometric Results

The qualitative analysis of important constraints that were expected to affect adoption of soil and water conservation, were presented here. In this section, the selected explanatory variables were used to estimate the binary logistic regression model to analyze the factors that affect the adoption of soil and water conservation. A binary logistic regression model was fitted to estimate the effect of hypothesized variable such as educational level, farming experience, farm size, family size, slope of land, distance from home to farm plot and perception of farmers about land degradation problems on the probability of being adopter or non adopter of soil and water conservation. The maximum likelihood methods was used to obtain the parameter estimates of the logistic regression model and statistically significant variables were identified in order to make measurement of the relative importance on the farmers' soil and water conservation (Table 6).

Table 6. *Summary of explanatory variables included in the binary logistic regression model*

Variable	Coefficient	Standard error	z-value	p-value	Odd ratio
Dima Bite micro-watershed					
FAMS	0.04	0.72	0.06	0.95NS	1.04
EDCL	3.6	2.1	1.73	0.08NS	37.7
FEXPER	0.3	0.17	1.8	0.07NS	1.37
FARMS	1.2	0.8	2.2	0.032**	0.75
DFHF	-0.15	0.06	-2.3	0.02**	0.86
SLOP	2.37	0.98	2.41	0.016**	10.74
PECLDP	-0.8	1.44	-0.55	0.58NS	0.45
constant	-15.4	8.6	-1.78	0.076	
Finchawa micro-watershed					
FAMS	2.02	1.5	1.31	0.18NS	7.57
EDCL	-0.84	1.26	-0.7	0.50NS	0.43
FEXPER	0.5	0.03	2.20	0.021**	1.45
FARMS	1.35	2.14	0.63	0.53NS	3.8
DFHF	-0.17	0.07	-2.23	0.026**	0.84
SLOP	3.14	1.04	2.63	0.008***	21.3
PECLDP	-3.13	2.8	-1.10	0.27NS	0.04
constant	-14.74	6.7	-2.19	0.02	

Pearson Chi-square = 72.5 and 53.93 for Dima Bite and Finchawa, respectively
-2Log likelihood = 11.4 and 10.3 for Dima Bite and Finchawa, respectively

Note: ** = Significant at ($p<0.05$), *** = highly significant at ($p<0.01$), NS= Non Significant

The result indicated that among seven hypothesized explanatory variables four variables were determining factors affect the adoption of SWC measures in the two micro-watersheds (Table 6). The farm size (FARMS) in Dima Bite, farming experience (FEXPER) in Finchawa and the distance from home to farm plot (DFHF) and slope of the land (SLOP) was significant variable in the two micro-watersheds.

Interpretation of econometric results

Farm size (FARMS): The results indicated that farm size was significant at ($p<0.05$) and positive relationship with the adoption of stone and soil bunds in the Dima Bite. Suggesting that farmers who hold large farms were more likely to invest in conservation practices, whereas farmers' who hold small farms size were less adoption to SWC measures. The result was similar with the findings of Aklilu and Graaff (2007) in Ethiopian highland watersheds, the adoption of SWC is low among farmers with small farm size and high with large farm size and others various studies Wagayehu and Lars (2003), Ersado *et al. (*2004) and Aklilu (2006) indicated positive relation between adoption of soil and waterconservation practices and farm size.Other variable held constant, the odds ratio in favor to use selected SWC practices increases by a factor of 0.75 for one extra unit increase of farm size of the farmers in Dima Bite (Table 6).

Farming experience (FEXPER): Farm experience has positive relation with adoption of soil and water conservation at ($P< 0.05$). The positive sign showed that a longer farm experience, a better knowledge, attitude and skill was developed on the operation and construct of SWC. The odds ratio indicated that the adoption of stone and soil bunds practices were increased by a factor of 1.45 for an increase in farm experience by one year in Finchawa (Table 6). This result contradicts with the finding of Tsegaye (2014) indicated that as age of farming experience increased the adoption of SWC practice decreased. Because farmers who are in the old age have lack of information and labour to practices SWC.

Distance from home to farm plot (DFHF): The farm plot distance was significant at ($P< 0.05$) and related negatively with the farmers' adoption of soil and water conservation practices in the two micro-watersheds. This indicated that if households leave at far from farm plot, adoption and maintenances of SWC decreased and need human labour and time to implement. The odds ratio of 0.86 in Dima Bite and 0.84 in Finchawa indicates that other thing being constant, the odd ratio in favor of adoption of soil and water conservation practice increased by a factor of 0.86 and 0.84 in Dima Bite and Finchawa respectively as the distance of the homestead from the farm plot center decreased by one extra unit (Table 6). The study result supported by the finding of Abdi and Dereje (2015) farmers' who was near to their farm plot was more adoption to SWC practices and maintained than far away from the farm plot.

Slope of land (SLOP): Econometric result indicates that slope of the plot land has positive relation with adoption of soil and water conservation and significant at ($P<0.05$ and $p<0.01$) in Dima Bite and Finchawa respectively. Because slope was an indicator of soil and water loss from the farmland. Thus, farmers cultivating at sloping fields perceived the problem of soil loss than farmers who cultivate at gentle or level sloping fields. Farmers which have land from sloping area were more likely to adopt SWC technologies than on none sloping lands. Keeping other things held constant, the odds ratio showed that the adoption of stone and soil bund SWC practices increased by a factor of 10.74 and 21.3 for one extra unit increase of the slope land in Dima Bite and Finchawa micro-watersheds respectively (Table 6). The study results in agreement with the finding of Alufah *et al*. (2012) indicate that slope of land influence the adoption of SWC measures.

3.3 Perception of Farmers on Land Degradation

Land degradation

Majority of the farmers have confirmed that land was degraded from year to year, due to improper use of land and continuous cultivation of marginal lands. As respondents stated land degradation is a problem to (69.6%) of them in Dima Bite and to (79.6%) in Finchawa.

The causes of land degradation expressed by respondents were: population growth, over grazing, deforestation, inappropriate farming techniques, lack of adoption of soil and water conservation measures, ploughing marginal land and soil erosion in the two micro-watersheds. From the survey result (42%) and (55.6%) of respondents replied that soil erosion followed by population growths were the major causes of land degradation problems in Dima Bite and Finchawa respectively (Table 7). From total of respondents, (40.6%) in Dima Bite and (81.5%) in Finchawa stated that there were deforestation problems (Table 7). As comparison was made between the two micro-watersheds, Finchawa were more deforested than Dima Bite, because intervention of watershed management in Dima Bite not only reduced land degradation problems but also reduced the deforestation of forest by giving alternative source of fuels and source of incomes which reduce dependency on forest resources.

The major reason of deforestation as provided by most of respondents in Dima Bite that were used for agricultural lands (40.6%) and in Finchawa used as source of incomes (53.7%) (Table 7). During the focus group discussion the farmers responded that the main reason for deforestation of forest was due to high demand for arable land.

The result of deforestation was loss of biodiversity and degrades forestlands and finally might lead to changes the physico-chemical and biological attributes of surface soil and leave the land prone to erosion and lowering of soil quality as respondent replied in the two micro-watersheds. The major and common types of soil erosion problem occurred in the two micro-watersheds were soil erosion by water. Among the total respondents (87%) of respondents in Dima Bite and (90.7%) of respondent in Finchawa replied that soil erosion by water was the most common types of soil erosion problems (Table 7). The result was similar with the finding of Addise (2014) who indicated that the most of the soil erosion problem was caused by water agents.

The main consequences of land degradation problem expressed by respondents were loss of biodiversity, shortage of land, decreases livestock number and declining of crop yields. The result indicated that the most common consequences of land degradation problems were declining of crop yields (43.5%) in Dima Bite and (74.1%) in Finchawa (Table 7). As a result of mechanical soil and water conservation practices such as: terracing, stone bunds, soil bunds, micro-basin and integrating with biological measures, declining of crop yield in Dima Bite was reduced as compared to Finchawa. The result was similar to the finding of Tsozue *et al*. (2014) and Samuel (2013) who stated that most prevalent causes of land degradation is soil erosion and the final result of land degradation was decreasing crop productivity.

The perception of farmers on degree of land degradation problem was manifested as severe, medium and low. The degradation of land in Dima Bite was low (49.3%) and in Finchawa it was severe (70.4%) as most of respondent stated (Table 7). The result indicated that watershed management intervention decrease the degradation of land and increased the rehabilitation of land in Dima Bite by afforestation, establishing mechanical SWC structures integrated with planting of different moisture absorbing grass which is reducing soil erosion and in other case reduce land degradation problems.

Table7. *Summary of households' perception on land degradation problems*

Variables	Dima Bite		Finchawa	
Causes of land degradation	Frequency	%	Frequency	%
Population growth	14	20.3	8	14.8
Deforestation	5	7.2	7	13
Over grazing	2	2.9	4	7.4
Ploughing marginal land	6	8.7	1	1.85
Lack of adoption of SWC measures	6	8.7	3	5.5
Inappropriate farming techniques	7	10.1	1	1.85
Soil erosion	29	42	30	55.6
Deforestation of forest	Frequency	%	Frequency	%
Yes	28	40.6	44	81.5
No	41	59.4	10	18.5
Reason for deforestation	Frequ	%	Frequ	%

	ency		ency	
Use for fire wood	16	23.2	8	14.8
Use for agricultural land	28	40.6	10	18.5
Use for construction purpose	15	21.7	7	13
Use as source of income	10	14.5	29	53.7
Types of soil erosion	Frequ ency	%	Frequ ency	%
Soil erosion by water	60	87	49	90.7
Soil erosion by wind	9	13	5	9.3
Consequence of land degradation	Frequency	%	Freque ncy	%
Loss of biodiversity	7	10.1	4	7.4
Shortage of lands	15	21.7	7	13
Decrease livestock number	17	24.6	3	5.6
Declining of crop yields	30	43.5	40	74.1
Degree of land degradation	Frequen cy	%	Frequ ency	%
Severe	10	14.5	38	70.4
Medium	25	36.2	12	22.2
Low	34	49.3	4	7.4

Total	69	54 100	100

3.4. Land Rehabilitation Practices in the Watershed

The current pressure on land has already been recognized and land degradation became a major problem in the two micro-watersheds. By considering the problem of land degradation, watershed management practices were undertaken in Dima Bite. Majority of farmers (65.2%) of the total respondents has viewed about land rehabilitation practices in Dima Bite and (89.2%) were adopters and (37.5%) were non-adopters (Table 8). Among the total respondent (50%) of them have no any view about land rehabilitation practices and (69%) were adopters and (28%) were non-adopters in Finchawa (Table 8).

In Dima Bite more farmers were adopter and in Finchawa more farmers were non-adopters because of lack of awareness creation. The chi-square test showed that there were statistically highly significant (x^2=20.2 and 9.01) differences between the two groups at ($p<0.01$) in Dima Bite and Finchawa, respectively (Table 8). This showed that land rehabilitation and adoptability of SWC was positively correlated. This means that farmers perceived the rehabilitation of land as compared to the one who perceived that the adoption of soil and water conservation could not bring the rehabilitation. The finding was similar to the finding of Melese (2014) stated that land degradation can be rehabilitated by adoption of mechanical and biological soil and water conservation practices.

As respondents answered the integration of mechanical and biological SWC measure (52.2%) were the major land rehabilitation practices in Dima Bite and traditional SWC measure (68.5%) were the major land rehabilitation practices in Finchawa (Table 8). Watershed management intervention integrated the land rehabilitation practices for common out puts which strengths the structure and sustain for long time as compared to Finchawa.

Table8.*Land rehabilitation practices by sample households*

Dima Bite							
Land rehabilitation practices	Adopters(37)		Non-adopters(32)		Total		X^2-value
	Number	%	Number	%	Number	%	
Yes	33	89.2	12	37.5	45	65.2	20.2***
No	4	10.8	20	62.5	24	34.8	
Total	37	100	32	100	69	100	
		Fincha					

wa

Land rehabilitation practices	Adopters(29)		Non-adopter(25)		Total		X^2-value
	Number	%	Number	%	Number	%	
Yes	20	69	7	28	27	50	
No	9	31	18	72	27	50	9.01***
Total	29	100	25	100	54	100	

Main land rehabilitation practices	Dima Bite		Finchawa	
	Frequency	%	Frequency	%
Improved mechanical SWC measure	21	30.4	12	22.2
Improved biological SWC measure	9	13.1	5	9.3
Traditional SWC measures	3	4.3	37	68.5
Integration of mechanical and biological SWC measures	36	52.2	0	0
Total	69	100	54	100

Note: *** = Significant ($p<0.01$)

4. Conclusions

watershed management practices has positive and significant impact on crop yield, livestock productivity, availability of water resource, greenness of the environment, improve household income and increase soil and water conservation practices and finally they perceive that watershed management was reduce soil erosion and increase fertility of the soil.

Most of the respondents perceived about the problems, causes and consequences of land degradation and agreed that population growth, deforestation, overgrazing, ploughing marginal land, lack of adoption of SWC measures, inappropriate farming techniques and soil erosion by water were the major causes of land degradation problem and the consequences of land degradation were loss of biodiversity, shortage of land, decrease livestock number and declining of crop yields. The result of binary logistic model showed that adoptability of stone and soil bunds were significantly influenced by slope of land, farm size, farming experience and distance from home to farm plot of respondents and significant at ($p<0.05$) and ($p<0.01$) in the two micro-watersheds. The overall findings indicated that, the intervention of watershed management practice not only increase crop yield and livestock production but also it has high contribution to increases the perception, adoption, participation, and maintenance of implemented watershed management practices.

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