Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 20 Issue 3 Version 1.0 Year 2020
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Assessing the Impact of Watershed Management Interventions on Livelihood of Small- Scale Farmers and Ecosystem Services in Choke Mountains, East Gojjam Zone of Amhara Region, Ethiopia

By Yenealem Gemi & Belay Semane
Addis Abeba University

Abstract- In Ethiopia, natural resources management interventions have been implemented since the 1980s to restore degraded landscapes. However, little efforts have been made to investigate the impacts of natural resources management interventions on ecosystem services and livelihood. This study was conducted in the Choke Mountain, Northern Ethiopia, to investigate the effects of community-based watershed management interventions on ecosystem services and livelihood of smallholder farmers. Both qualitative and quantitative methods were used to collect and analyze data. The results indicated that deforestation, population pressure, topography, overgrazing, and continued cultivation are major causes of land degradation. Consequences of land degradation include a reduction in farm size, a decrease in soil fertility and crop production, drought, food insecurity, and poverty. Also, the results demonstrated that a shortage of clean water and a decline in vegetation composition are among the impacts of land degradation on ecosystem services.

Keywords: benefit-sharing, land degradation, local communities, watershed management interventions, participation.

GJSFR-H Classification: *FOR Code: 960305*

ASSESSINGTHEIMPACTOFWATERSHEDMANAGEMENTINTERVENTIONSONLIVELIHOODOFSMALLSCALEFARMERSANDECOSYSTEMSERVICESINCHOKEMOUNTAINSEASTGOJJAMZONEOFAMHARAREGIONETHIOPIA

Strictly as per the compliance and regulations of:

Assessing the Impact of Watershed Management Interventions on Livelihood of Small- Scale Farmers and Ecosystem Services in Choke Mountains, East Gojjam Zone of Amhara Region, Ethiopia

Yenealem Gemi [α] & Belay Semane [σ]

Abstract- In Ethiopia, natural resources management interventions have been implemented since the 1980s to restore degraded landscapes. However, little efforts have been made to investigate the impacts of natural resources management interventions on ecosystem services and livelihood. This study was conducted in the Choke Mountain, Northern Ethiopia, to investigate the effects of community-based watershed management interventions on ecosystem services and livelihood of smallholder farmers. Both qualitative and quantitative methods were used to collect and analyze data. The results indicated that deforestation, population pressure, topography, overgrazing, and continued cultivation are major causes of land degradation. Consequences of land degradation include a reduction in farm size, a decrease in soil fertility and crop production, drought, food insecurity, and poverty. Also, the results demonstrated that a shortage of clean water and a decline in vegetation composition are among the impacts of land degradation on ecosystem services. The local communities perceive that watershed management interventions support to restore ecosystem services and improve livelihood. They are also optimistic that degraded landscapes can be restored through the implementation of watershed management interventions, and have been contributing to the establishment of watershed management interventions on communal and private lands mainly through providing free labor. Collaboration among local communities, government, and non-governmental organizations is key to sustain the implemented watershed management interventions.

Keywords: benefit-sharing, land degradation, local communities, watershed management interventions, participation.

I. Introduction

Land degradation includes all process that diminishes the capacity of land resources to perform essential functions and provide ecosystem services (Hurni et al., 2010). It is usually caused by two complex interlocking systems: the natural ecosystem and the human social interaction. The impact of land degradation on livelihood is particularly severe in Sub-Saharan Africa because 65% of the population is rural and the main livelihood of about 90% of the population is agriculture (Project Development Facility, 2007).

Ethiopia is one of the rich countries in Sub-Saharan Africa in terms of natural resources (Gete et al., 2006). However, natural resource degradation in Ethiopia has been going on for centuries (Hurni et al., 2010). The problem is getting worst as the population pressure and the demand for food, fuel wood, building materials, and land for cultivation increases (Hurni et al., 2010).

The Choke Mountain and its associated watersheds, located in the Blue Nile highland regions of Ethiopia, is broadly representative of many of the challenges related to land degradation. The Choke Mountain ecosystems are under threat from multiple sources, including the pressure from population growth, soil erosion, deforestation, overgrazing, and decline of soil fertility (Simane et al., 2013). In turn, it has affected the livelihood of local communities through mainly reducing water availability, and livestock feed (Simane et al., 2013).

To combat land degradation and restore degraded landscapes, the Ethiopian government launched a massive soil and water conservation program in the middle of the 1970's (Hawando, 1997). Particularly, soil and water conservation campaign has been implemented since 2010 to increase agricultural productivity through improved natural resource management (Mekuria et al., 2017). The objectives of the study was to (1) Investigate the causes and consequences of land, (2) Investigate the contribution of the implemented watershed management interventions to enhancing ecosystem services and livelihood of smallholder farmers, (3) Identify the concerns of local communities on watershed management practices, (4) Investigate factors affecting the preference of the intervention by the communities, and (5) Explore the

Author α: Southern Agricultural Research Institute (SARI), Worabe Agricultural Research Centre, Worabe, Ethiopia.
e-mail:gemiyenealem@gmail.com
Author σ: College of Development Studies, Center for Environment and Development, Addis Abeba University, Addis Abeba, Ethiopia.

contribution and responsibilities of the society in managing natural resources and restoring the degraded ecosystem.

II. Materials and Methods

a) Description of the study area

The study was conducted at Choke Mountains (Figure 1). It is located on plateaus that rise from a block of meadows and valleys and have elevation ranging from approximately 800 to 4200 m above sea level. The central peak is located at 10050'24" N and 370 58'24" E. The watershed is found entirely in Eastern Gojjam Zone of six Woredas such as; Bibugne, Debay Tilatgin, Gozamen, Hulet Eju Enssie, Machakel, and Senan (Bewket, 2010). As measured at Debre-Markos weather station, mean annual temperature is 14.50C with a range from 13.2°C in July and August to 17.3°C in March. Average annual precipitation ranges from 600 to 2000 mm year-1, and exhibits local variability associated with topographic gradients (Simane 2011). Dominant soil types are volcanic in origin, derived from Mio-Pliocene shield volcano lavas and, at lower elevations, Oligocene flood. The dominant agricultural practice in the Choke Mountain watersheds is crop-livestock mixed systems (Simane 2013).

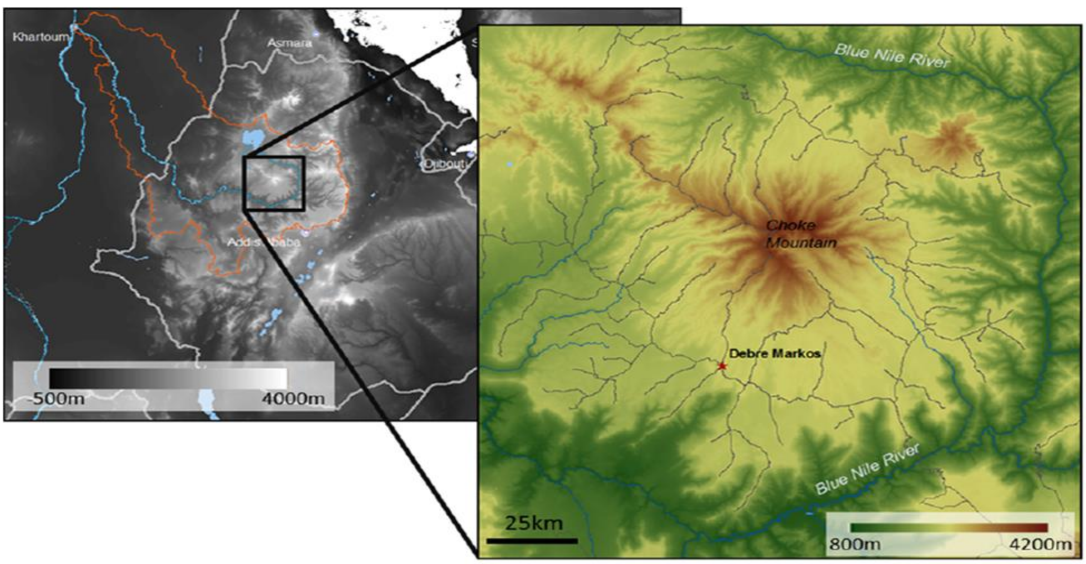


Figure 1: The location map and topography of Choke Mountain watersheds

In figure 1 above, the red line indicates the outline of the Blue Nile River basin and shading is topography. In the Choke Mountain region inset, colors are topography, blue lines are major rivers, and grey lines are roads (Simane, 2013).

b) Sampling technique, sample size and data sources

Purposive sampling was used to select the study Woredas and Kebeles as well as the specific watersheds. The main criteria used to select the study woreda and kebeles was based on their agro-ecology, the presence or absence of well-designed watershed management interventions, and accessibilities. Accordingly, four Kebeles with well-designed watershed management interventions and four less sustained were selected. Then from each kebele, a watershed was selected to investigate the effectiveness of watershed management interventions to enhancing ecosystem services and improving livelihood. In total, eight watersheds were selected. Systematic random sampling was used to select respondents for the household survey. A total of 120 respondents were selected from the 1897 total number of households using the (Cochran, 1977) formula.

$$n0 = \frac{z2pq}{d2} \rightarrow n = n0/1+\frac{n0-1}{N}$$

Where, no = the desired sample size when the population is greater than 10,000. n = number of sample size when the population is less than 10,000 z = is statistical certainty at 95% confidence limit i.e. 1.96 p = 0.1 (proportion of the population to be included in the sample i.e. 10%). q = 1 – pi.e. (0.9) N = total number of the households (1897), d = degree of accuracy desired (0.05).

Also, 20 key informants (five from each of the selected Woreda; were selected for key informant's interviews. The Key informants comprise of watershed management experts at district and regional level, development agents and watershed committee. Further, focus group discussion was held to strengthen the information gathered through household surveys and key informant interviews. During the entire study, 12 focus group discussions were held (i.e., three from each Woreda).

The qualitative design approach was applied to describe meaning, concepts and definition of data in word when the quantitative approach was applied to describe quantitative data in the statistical method. And also have applied both primary and secondary data sources and data collection techniques. Primary data was generated through a household survey, focus group discussion, and key informant interview. Secondary data was collected from published and grey literature as well as from government official documents obtained from district agricultural offices. To investigate changes in ecosystem services and human livelihood following watershed management interventions, participatory tools such as household survey, focus group discussion, key informant interviews, and transect walk was used.

i. *Qualitative data collection*

a. *Assessment of the perception of local communities*

Semi-structured questionnaires were prepared to gather data. Both open and close-ended questions were included in the questionnaires. The open ended questions were developed to enable the respondents to give responses by their language freely. The questions in this study were prepared in a simple and clear way and arranged in a logical order to make it more inclusive. The questionnaires were first developed in English language and then translated into Amharic language. The questions focused on land degradation problems, participation, and perception of the communities towards the implementation of watershed management interventions, changes in ecosystem services, and livelihood following the implementation of interventions, the rate of adoption of interventions, tradeoffs of interventions, and local communities concerns on interventions.

c) *Data analysis*

The methodologies employed to analyze the data for this study was included descriptive statistics. Descriptive statistics (frequency, percentage, mean, minimum and maximum values of the variables used to summarize a collection of data in a clear and understandable way as well as constructed tables and figures was used to show respondents' attitude towards individual items of the questionnaire. Inferential Statistics was used to draw inferences about a population from a sample. All the gathered data were carefully entered into Microsoft Excel. Editing and coding of numerical symbols to answers were made. After completion of editing, assigning, or coding, finally, data were exported from the program Microsoft Excel to Statistical Package for Social Science, version 20. Then, descriptive statistics, and correlation were used for analysis. The qualitative data from individual interviews were analyzed using content analysis (Bernard, 2006).

III. Results and Discussions

a) *Driving forces of land degradation*

Survey respondents and key informants considered that population pressure and over utilization of natural resources as the main driving forces of land degradation. Consequently, 40% of respondents in Mechakel woreda considered over utilization of natural resources as main driving force, while population pressure was considered as the main cause by 26.7% of respondents. In Shebel Berenta woreda, 26.7% of respondents considered over utilization of natural resources as the main driving force, while a population pressure was considered as the main cause by 40.0% of respondents. In Shewa k/mihret kebele 66.7% of sampled households considered the topographic condition of the areas as the main driving force of land degradation and also this are supported by field observation (Picture 1). Few (5%) of respondents considered road construction and poorly designed diversion ditches as driving forces of land degradation. The results from focus group discussion also confirmed that population pressure, lack of implementation of conservation measures, and poor land management, as the main driving forces of land degradation. The result also demonstrated that family size and land degradation is positively correlated ($r = 0.24$; $p < 0.05$) (Table 5 below).

The results also revealed that poor implementation of policies related to NRM, lack of awareness raising campaigns towards the implementation of natural resources management interventions and lack of rules and regulation that support the sustainable management of natural resources contributed to land degradation in the study areas.

Picture 1: Topographic features of Shewa k/mihret, source: photo taken during field observation 2016/17 (Photo source. Yenealem Mekuria)

Simane et al. (2013) also demonstrated that land degradation in the highland areas (i.e. Areas above 1500 m.a.s.l) had been a concern for many years and steep slopes that promote rapid erosion as well as limited agricultural land characterize the Choke environment. Similarly, the study conducted in Choke Mountain (Shegaw, 2011) and the southern part of Ethiopia, revealed that steep topography and population pressure are the main driving forces of land degradation (Worku, 2016).

b) Pressures on the natural environment

Survey respondents, key informants, and field observation confirmed that deforestation, overgrazing, and high rate of soil erosion are the main pressures on the natural environment that lead to severe land degradation. A considerable proportion of respondents (19.2%) considered overgrazing as the main pressure on natural environment and aggravates soil erosion and land degradation. Similarly, 8.3% of respondents reflected deforestation and overgrazing, as the major pressures (Table 4). In this line, (Simane et al., 2013) indicated that soil erosion in Choke Mountain watersheds is a well-recognized problem and a priority area for intervention. The results demonstrated that the perception of local communities on major driving forces of land degradation and pressures varies across the studied kebeles (Table 1).

Table 1: Driving forces of land degradation and pressures on the natural environment as perceived by sampled respondents

	Shebel berenta		Mechakel		Sinan		Awabel		
	Led	Geda	A.Z	D.K	S.K/M	Dan	E.C	Yek	Agg in (%) for n= 120
Deforestation	0.0	33.3	13.3	26.7	6.7	0.0	26.7	20.0	10.8
Overgrazing	33.	13.3	0.0	0.0	20.0	0.0	46.7	13.3	19.2
Continuous cultivation	6.7	6.7	6.7	0.0	20.0	6.7	6.7	26.7	10.0
Limited use of conservation structures	6.7	20.0	6.7	26.7	6.7	6.7	20.0	40.0	12.5
If 1,2	6.7	20.0	0.0	13.3	6.7	0.0	0.0	0.0	8.3
If 1,2,3	6.7	0.0	26.7	26.7	0.0	0.0	0.0	0.0	2.5
If 1,2,3,4	13.	0.0	20.0	6.7	13.3	80	0.0	0.0	19.2
If 1,3,4	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	3.3
If 2,3	0.0	0.0	0.0	6.7	6.7	0.0	0.0	0.0	2.5
If 2,3,4	0.0	6.7	0.0	13.3	6.7	0.0	0.0	0.0	4.2
If 2,4	0.0	0.0	0.0	6.7	6.7	0.0	0.0	0.0	1.7
If 3,4	0.0	0.0	0.0	13.3	0.0	0.0	0.0	0.0	0.8
If others	26	0.0	0.0	0.0	6.7	6.7	0.0	0.0	5.0
Missing	6.7	40.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: computed from household survey data 2016/17

Note: one is for Deforestation, two is for overgrazing, and three is for continues cultivation, and four is for limited use of conservation structures

Note: Led is for Ledie, Geda is for Gedayasu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate

The results of this study indicated that existence and severity of soil erosion varies across studied kebeles (Table 5). According to the survey respondents, Sinan and Mechakel districts are the most affected compared to Awabel and Shebel berenta districts. Also, all of the respondents in Sinan district in Dangule kebele confirmed the existence of soil erosion in their area as high. In contrast, the majority of respondents in Awabel woreda in Enebiy Chifar and Yekeyit kebele (93% and 60%) respectively, confirmed that they did not observe soil erosion in their farmland.

The majority (45%) of respondents indicated the severity of soil erosion in the studied areas as high, while an equal proportion of respondents indicated the severity of soil erosion as medium and low (Table 2). (Lal, 1981, Eswaran et al., 2001 and Tesfahunegn, 2013) have mentioned that exploitation of soil resources by farmers, resulting from a need to increase agricultural productivity, aggravates soil erosion. The study further claims that the severity of soil erosion is higher in developing countries, where the economy mainly depends on agriculture.

Table 2: The severity of soil erosion as perceived by respondents

	Shebel berenta		Mechakel		Sinan		Awabel		
Severity of soil erosion	Led	Geda	A.Z	D.K	S.K/M	Dan	E.C	YEK	Agg in % for n=120
Low	13.3	40.0	13.3	0.0	6.7	0.0	93.3	60.0	28.3
Medium	53.3	40.0	46.7	13.3	20.0	0.0	6.7	33.3	26.7
High	33.3	20.0	40.0	86.7	73.3	100.0	0.0	6.7	45.0

Source: computed from own household survey data 2016/17

Note: Led is for Ledie, Geda is for Gedayasu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate

The rate of soil erosion, as the majority of respondents, confirmed the rate of soil erosion as high, while the other respondents do not consider soil erosion as a major problem. In the Choke Mountain, soil erosion is a key environmental and socio-economic problem.

Topography has a strong influence on aggravating soil erosion. On the other hand, the result indicates that the implementation of NRM interventions in Choke Mountain is a key to control soil erosion and restore degraded landscapes. Also it is consistent with the perception of local communities; the majority of respondents confirmed the effectiveness of the implemented natural resource management intervention in reducing soil erosion (see section 3.4).

c) State of the natural environment in Choke Mountain

The majority of (87.5%) survey respondents perceive that the productivity and the size of their farm land have declined through time. For example, 93.4 % of respondents in Dangule and Gedayasu kebele considered that their farm land is reduced; fertility of agricultural soil and productivity is declined due to increased soil erosion, whereas 40.0 % of respondents in D/kelemo elaborated that, land degradation has resulted in reduced land size and agricultural production. Similarly, 40% of respondents in Yekeyit kebele discussed a reduction in farm size due to land degradation (Table 3). The results also indicated that the deterioration of the natural environment as a consequence of land degradation varied across the studied kebeles, and is more severe in Gedayasu and Dangule kebeles than the other studied kebeles. A survey respondent elaborated the state of the natural environment as:

"The decline in soil fertility and reduced workability of farm lands due to land degradation has led to reduction in crop production. Also, land fragmentation due to land degradation has resulted in reduced crop production. This, in turn, resulted in food insecurity, reduced income, and poverty". (Interview 2016/17)

The reduction in agricultural productivity could be attributed to poor land management and land degradation due to soil erosion. The survey respondents have mentioned that they started to use different land management practices such as crop rotation, application of inorganic fertilizers and compost, and fallowing to restore degraded farm lands. Also, farmers also use irrigation and planting of fruit trees to diversify their livelihood. However, 9.2% of the respondents did not perceive that the productivity of their land is declining.

Table 3: State of the current natural environment in Choke Mountain as perceived by respondents

		Shebel berenta		Mechakel		Sinan		Awabel		Agg in % for n= 120
		Led	Geda	A.Z	D.K	S.K/M	Dan	E.C	YEK	
Consequence of LD	Reduce in farm size	20.0	0.0	0.0	0.0	20.0	0.0	20.0	40.0	12.5
	Rise in soil erosion	0.0	0.0	0.0	0.0	0.0	0.0	33.3	13.3	0.8
	Decreasing SF and LP	20.0	6.7	13.3	6.7	20.0	6.7	26.7	13.3	25.8
	If 1,2,3	13.3	93.4	66.7	53.4	13.3	93.4	0.0	6.7	38.6
	If 1,3	40.0	0.0	13.3	40.0	40.0	0.0	0.0	6.7	15.1
	If 2,3	6.7	0.0	0.0	0.0	6.7	0.0	0.0	0.0	2.5
	If others	0.0	0.0	0.0	0.0	0.0	0.0	20.0	20.0	0.0
	Drought	40.0	33.3	33.3	33.3	53.3	46.7	13.3	26.7	35.0
	Food insecurity	0.0	0.0	6.7	26.7	0.0	0.0	46.7	53.3	16.7
	Poverty	6.7	0.0	0.0	0.0	0.0	0.0	20.0	20.0	5.8
	If 1,2	46.7	53.3	26.7	33.3	0.0	6.7	20.0	0.0	23.3
	If 1,2 ,3	6.7	13.3	33.3	0.0	46.7	26.7	0.0	0.0	15.8
	If 1,3	0.0	0.0	0.0	6.7	0.0	20.0	0.0	0.0	3.3

Source: computed from own household survey data 2016/17

Note: one is for reducing in farm size, two is rise in soil erosion, and three is for decreasing soil fertility and land productivity

Note: one is for drought, two is for food insecurity, and three is for poverty

Note: LD is Land Degradation, SF is Soil Fertility and LP is Land Productivity

Note: Led is for Ledie, Geda is for Gedayasu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate

d) Impact of land degradation on ecosystem services and livelihood

The survey respondents, key informants, and focus group discussion confirmed that, shortage of clean air and water (mentioned by 27.5% of respondents), and decline in vegetation composition (24.2%) are among the impacts of land degradation on ecosystem services (Table 4). The majority of survey respondents confirmed that, they experienced deterioration of their livelihood due to degradation of ecosystem services.

Particularly, 100.0% of respondents in Gedayasu kebele revealed that, they faced a serious problems including drying up of water bodies due to degradation of ecosystem services (Picture2).

A survey respondent elaborated this as:

"The negative impacts of land degradation on ecosystem services has resulted in drought, drying up of water bodies and shortage of water supply as well as shortage of animal feed, occurrence of flood, and out migration"(Interview2016/17)

Another respondent further elaborated on this as:-

"Degradation of ecosystem services due to land degradation has resulted in decline in productivity (e.g., reductions in honey, milk, and meat), loss of soil fertility, loss of shelter for animals, food insecurity, loss of living house due to flood, shortage of clean water and exposing to water borne diseases''(Interview 2016/17).

Table 4: Perceptions of respondent's on impact of land degradation on ecosystem services

	Shebel berenta		Mechakel		Sinan		Awabel		Agg in %for n=120
	Led	Geda	A.Z	D.K	S. K/M	Dan	E.C	YEK	
Shortage of clean water	66.7	20.0	26.7	6.7	33.3	6.7	20.0	40.0	26.7
Creates complexity to regulate erosion problem	0.0	0.0	6.7	33.3	6.7	13.3	0.0	0.0	7.5
Leads to high emission rate of carbon dioxide	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leads to decline in vegetation composition	0.0	0.0	13.3	20.0	33.3	0.0	60.0	40.0	23.3
If 1,2	6.7	0.0	0.0	6.7	6.7	20.0	0.0	0.0	4.2
If 1,2,3	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	2.5
If 1,2,4	0.0	0.0	20.0	20.0	0.0	20.0	0.0	0.0	7.5
If 1,3	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.8
If 1,4	26.7	53.3	0.0	6.7	6.7	6.7	20.0	20.0	18.3
If 1,2,3,4	0.0	6.7	33.3	0.0	6.7	0.0	0.0	0.0	5.8
If 2,4	0.0	0.0	0.0	13.3	0.0	13.3	0.0	0.0	3.3

Source: computed from own household survey data 2016/17

Note: one is for shortage of clean water, two is for creates complexity to regulate erosion problem, three is for Leads to high emission rate of carbon Dioxide, and four is for leads to decline in vegetation composition.

Note: Led is for Ledie, Geda is for Gedayasu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate.

Also, the household survey respondents pointed out that drought and food insecurity are among the impacts of land degradation. For example, drought was mentioned by 35% of respondents as the main impact of land degradation. Similarly, food insecurity was mentioned by 16.7% respondents. Both food insecurity and drought were mentioned as impact of land degradation by 23.3% of respondents. Few (3.3%) of the survey respondents has mentioned the reduction in the number of livestock as one of the impacts of land degradation.

Different studies have revealed that the impacts of land degradation on ecosystem services have direct impacts on human societies (Cardinale et al., 2012; Berendse et al., 2015; Brevik et al., 2015; Yazdani et al., 2015). Thus, the prevention of land degradation for sustaining the food and energy security is a significant concern for mankind. A study indicated that soil erosion which is particularly severe in Ethiopia is the major indicator of soil loss and soil fertility decline (Haile et al., 2015). The positive correlation between impact of land degradation on ecosystem service and on human livelihood ($r = 0.168$, $p > 0.05$) also supports that enhancing ecosystem services through reducing land degradation is key to improve the livelihood of rural communities (Table 5).

Table 5: Correlation analysis result Correlations

Correlations	MS	EDU	TLS	TFS	OCC	Impacts of LD on HLV	Impacts of LD on ES
MS							
EDU	-.322**						
	.000						
TLS	.040	-.091					
	.670	.325					
TFS	.156	-.216*	.329**				
	.089	.018	.000				
OCC	.013	.178	-.063	.032			
	.888	.051	.498	.730			
Impacts of LD on HLV	.094	-.039	.277**	.125	.067		
	.308	.671	.002	.174	.469		
Impacts of LD on ES	.203*	-.065	.071	.099	.040	.168	
	.026	.479	.443	.280	.665	.067	

Note: MS is for marital status, EDU is educational status, TLS is total land size, TFS is total family size, OCC is occupational status, LD is land degradation, HLV is the human livelihood, and ES is ecosystem services.

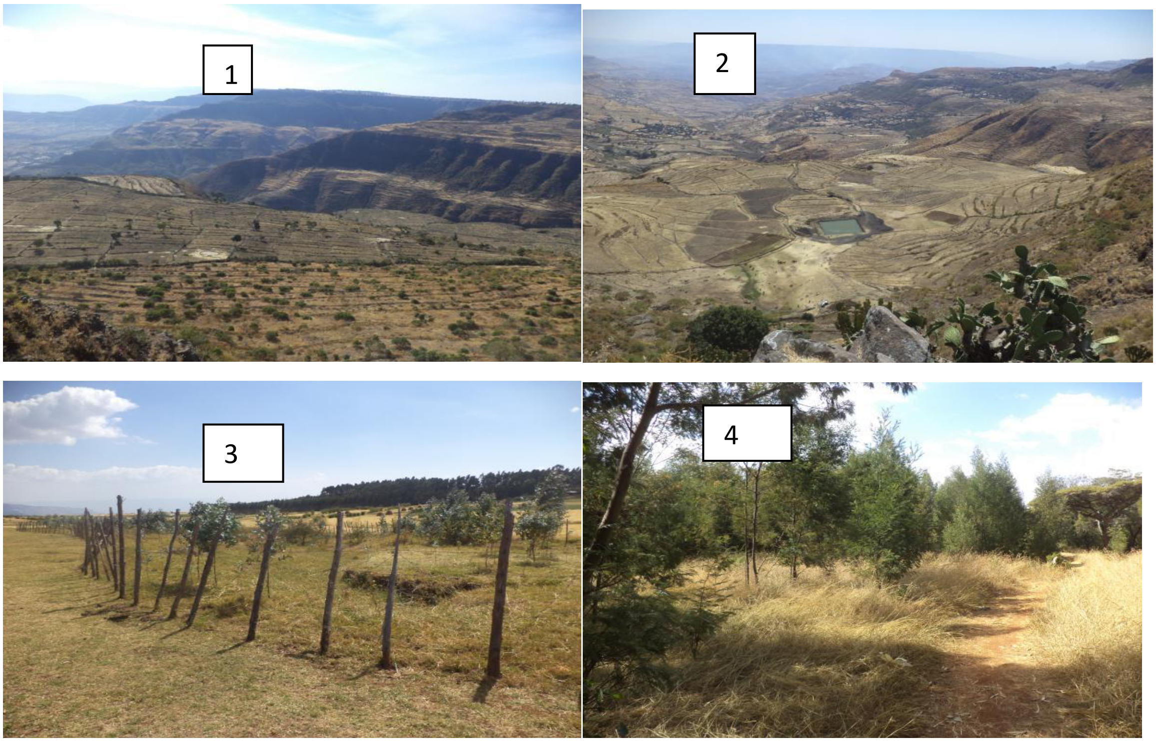
e) Response to land degradation in the Choke Mountain and benefits from the watershed management interventions

The implemented Watershed management interventions in the studied kebeles includes terraces, trench, exclosure, afforestation, and diversion ditches to address land degradation and improve ecosystem services and livelihoods (Picture 2). The survey respondents, key informants and results from FGD confirmed that the implementation of watershed management interventions was jointly done by the government and local communities.

A survey respondent elaborated on this as:

> *"We adopted the construction of terraces and bunds mainly to protect our land from soil erosion and thereby improve the fertility of soil and agricultural productivity. Also, we adopted soil and water conservation measures to harvest water for the dry season, improve water holding capacity of the soil and increase the workability of farm lands as well as enhance the effects of inorganic fertilizers in increasing crop yield".*

The majority (68.9%) of the respondents confirmed that they implemented at least one conservation measure to control soil erosion and restore degraded landscapes. Although there is variability in the adoption rate of conservation measures, the majority (64.8%) of respondents confirmed that they adopted soil and water conservation measures on their farm land. The result also indicated that soil and water conservation measures had been more adopted in Sinan district than the other studied districts. The most adopted conservation measures are the construction of terraces on farm lands (mentioned by 53-87% of respondents). The results also confirmed that the implemented soil and water conservation measure had been introduced to the local community by the agricultural development agents. However, the local communities have participated during the implementation stages.



Picture 2: Implemented natural resources management interventions in the studied kebeles

Note: pic. One, is in Gedayasu, pic. Two, is in Ledie, pic. Three, is in Enebiy Chifar, and pic. Four, is in D/kelemo kebele. (Photo source: Yenealem Mekuria, captured during the field visit 2016/17)

The majority of survey respondents perceive that, land degradation minimized through different watershed management interventions. However, out of the total households, 14% of respondents perceive that the problem of land degradation can't solve using watershed management interventions. Those survey respondents who were optimistic about the possibility of minimizing land degradation suggested several natural resources management interventions such as terrace, diversion ditches, afforestation, and controlled and rotational grazing. Also, these respondents recommended that, planting of grasses and forage trees on the banks of soil and water conservation measures to stabilize the structures and produce livestock feed. Those who are pessimistic justified their opinion that, once a land has lost its fertility, it is difficult to restore within a short period and convert it in to productive land. However, soil degradation can reverse by restoring degraded land and the implementation of recommended management practices (Lal, 2015). Protection and restoration of land use on slopes are very important to minimize soil erosion, which will not only contribute to greater safety in many land uses around the world but will also help to maintain soil and quality of water in a watershed (Giménez Morera et al., 2010; Wildemeersch et al. 2015; Mekonnen et al., 2014; Yazdani et al., 2015).

The survey respondents and key informants stated that all groups of local communities are benefiting from watershed management. For instance, out of the total respondents, 53.4% of respondents confirmed that the poor, medium and rich members of a community are benefiting equally. The sampled households were discussed on the idea and they have mentioned their views; such as the benefit from watershed management practice has brought considerable change on the livelihood of all community as well as on the ecosystem, and there is no difference depending on the wealth status. The watershed management practice has implemented for all, and all the communities are participating in watershed management practices because it has become the source of animal feed and fuel wood and shelter for animals. But, 12.5% of the respondents confirmed that the relatively wealthy members benefit more than the poor ones. These members of the community argue that the poor farmers forced to sell one of the tangible benefits of watershed management (i.e., grass) with a cheap price as they don't have livestock to feed. When there is the training they have the opportunity to be selected primarily, and the poor are needed only for their labor. Rich is protecting the land by using improved materials and producing much by participating in different production practices like farming and animal husbandry. In contrast to this, 30 % of respondents confirmed that the poor member of a community benefits more. Due to small agricultural land holdings, the poor are participating in protecting and restoring degraded land and changing it to give benefit for them in such approach, they are benefiting more through producing twice in a year, and they got good crop production due to reduction of soil erosion and improvement in soil fertility. Also, they got financial support from a safety net program.

The results of this study are inconsistent with the study by (Assefa, 2011) who reported that poor households in the Choke Mountain upper Muga watershed in East Gojjam, Ethiopia were fewer participants and beneficiaries of NRM interventions. A study conducted in central Tigray (Meaza, 2015) also shown that poor households are not equally benefiting from watershed management practices compared to the relatively wealthy families.

The key informant confirmed that the youth was also getting benefits from the interventions by providing opportunities for them to participate in animal husbandry, stone, and soil supply from the highly degraded areas with the support of technical advice by experts (Picture 3). According to the discussions with the key informants and as it's observed during field observation, the way they are getting the benefits from the watershed management intervention practices was almost similar in all the studied areas. There are benefit-sharing mechanisms in the studied communities, which is led by the watershed committee members.

Picture 3: enefit for the youths in animal husbandry by cutting grass from the WS in Ledie kebele, (Photo source: Yenealem Mekuria) taken during household survey 2016/17)

The local communities also have bylaws that support the management and use of natural resources. The main tangible benefit of watershed management interventions are livestock feed (mainly of grasses). As it was observed during the field visits, members of a watershed use the produced grass through a cut and carry system (Picture. 4). The bylaw is a key to ensure equity in benefit-sharing and control free riders.

Picture 4: Livestock feed (i.e., grass) obtained from the restored watershed, (source: photo taken during the field observation 2016/17)

f) The preference and effectiveness of watershed management intervention by the local community

The majority of the survey respondents, key informants, and results from focus group discussions confirmed that the implemented watershed management practices were effective. For instance, 78.7% of respondents revealed that, the interventions are vital and effective. However, 18% of respondents considered the interventions are ineffective. The majority (90%) of respondents considered as the implemented natural resource management activities are preferable in their area.

A survey respondent on the effectiveness of the interventions elaborated as:

"We preferred and implemented the interventions, as the practice has brought changes to the livelihood condition of the local communities through reducing soil erosion, increasing livestock feed, enhancing soil fertility, and agricultural productivity, and creating job opportunities. Also, the implemented conservation measures improve access to water supply and restoring degraded landscapes'' (Interview 2016/17).

A key informant also elaborated on this as:

"By looking at the benefits obtained from watershed management interventions, the local communities are motivated to expand conservation measures and cover degraded landscapes by vegetation. The implemented conservation measures have already brought changes in vegetation cover, availability of livestock feed, and increase the income of local communities''. (Key informant interview 2016/17).

The respondents who considered the implemented watershed management interventions ineffective justified their opinion as the implemented conservation measures are not sustainable, doesn't cover all the degraded land, all the communities are not protecting and controlling it and the implementation of watershed management interventions lacks participatory approach.

The sampled household respondents have mentioned main factors affecting the favorite of the intervention by the local community as;

The main factors affecting the preference of the measures by the local community were improvement in soil fertility and agricultural productivity, the lack of sustainability and short term benefit of the implemented soil and water conservation measures, the structures consume more land and lead to a decline in land size.

g) Contributions and responsibilities of communities related to the implementation of natural resource management interventions

Almost all of the survey respondents in all studied areas and key informants have confirmed that the members of the studied communities have contributions in the management of watersheds. The societies have been contributing to the implementations of natural resource management interventions on communal and private lands mainly through contributing free labor (Picture 3.6) (mentioned by 37.5% of respondents). Other studies also reported a similar result in that farmers in central Tigray, Ethiopia, provide support to the implementation of natural resource management interventions through providing free labor (Meaza, 2015). Such collaboration of local communities in watershed management activities can enhance the success of watershed management activities, as the participation of local communities is key to sustain natural resource management practices (Pretty and Ward, 2001 as cited in Meaza, 2015).

h) Conditions which initiates the community to participate in NRM activities

The participation of communities in natural resource management activities varies within the studied areas. For instance, 98.3% of the survey respondents in most of the studied kebeles have confirmed that all of the local communities have been participating in watershed management interventions in comparison 1.7% of respondents in D/kelemo kebele have confirmed that, all of the local communities have no any contributions in watershed management intervention practices.

The survey respondents and key informants indicated that the main factor that initiates local communities to participate in the implementation of natural resource management interventions is the severity of soil erosion in their locality. Other factors that affect the participation of local communities in watershed management include implementation period (majority indicated that watershed management activities needs to implement after March), material and financial support and follow-up by agricultural experts, and availability of short-term benefits from interventions. The respondents stressed that financial support and availability of short-term economic benefits from the interventions is key to participate in watershed management activities. The results suggest that generating short term economic benefits from watershed management activities could enhance the participation of local communities and the sustainability of implemented natural resource management interventions.

Some of the household survey respondents have also mentioned that, they have the interest in contributing and participate in watershed management practices if communities must control and protect the implemented natural resource management practices from damage. The respondents mentioned that awareness-raising and experience sharing campaigns are needed to enhance the interest of local communities to participate in watershed management activities. According to the respondents, training facilities, for example on afforestation practices, crop and animal husbandry systems as well as natural resource management practices could support to enhance the participation of local communities in the implementation of watershed management activities.

IV. Conclusion and Recommendations

The results demonstrated that a large proportion of the available land assigned for cultivation compared to grazing and other uses. The majority (55.7 %) of survey respondents perceive that the productivity of their farm land has declined through time. This could be attributed to poor land management (i.e., mono-cropping) and land degradation due to soil erosion. Land degradation resulted from population pressure, topography, deforestation, overgrazing, poor implementation of policies and strategies related to natural resource management, lack of awareness-raising campaigns is one of the major environmental and socio-economic problems of the study areas. The results indicated that the local communities well understood the negative consequences of land degradation on human livelihoods and ecosystem services. Local communities are also optimistic on the possibility of reversing degraded landscapes into productive land through the implementation of natural resource management interventions. The results of study also indicated that different types of natural resource management interventions were adopted in most of the studied areas, and the local communities considered the implemented natural resource management interventions are effective in restoring degraded landscapes and improving livelihood. The local communities perceived that providing training on afforestation practices, crop production, and animal husbandry systems as well as natural resource management practices could support to enhance the participation of local communities in watershed management activities. From the result of this study we recommend that, designing mechanisms to enhancing the short-term benefits of natural resource management interventions is key to increase the participation of local communities as well as integrating income generating activities such as livestock fattening and beekeeping could support to sustaining watershed management interventions through generating short-term economic benefits and building a sense of ownership. Finally, further studies are required to generate empirical evidence on the impact of natural resource management interventions on livelihood and ecosystem services and to inform decision makers.

Acknowledgement

First of all, glory to the almighty God, for his help throughout my whole life. I would like to express my profound and sincere thanks to my advisor Dr. Belay, for his valuable comments, constructive criticism, providing necessary data, and guidance throughout the study. I am also highly indebted to Dr. Ermias head of center of Environment and Developmental studies in Addis Abeba University for his cooperation in facilitating the opportunity to get financial support to undertake this research. I would like to thank to Mr. Desalegn Dawit and staff members of D/Markos University Dr. Mesfin, Dr. Getinet and Mr. Behailu, for their encouragement and helpful support through providing me transport facilitation during the field work.

I am grateful to provide heartfelt thanks to all my families to my mother Workinesh Mola and to my father Gemi Mekuria for their blessing and encouragement to my sister Ms. Jemanesh Gemi and to my brothers Mr. Tilahun Mekuria, Dr. Wolde Mekuria and his wife Dr. Mastewal Yami, Mr. Gorfu Gemi, Dr. Mulugeta Gemi and Mr. Dagnachew Mekuria for their unlimited follow up, encouragement, financial and material support more over being there for me when I need them throughout the study. My heartfelt thanks also goes to my friends, Zuriyash Tadesse and to all of my classmates, data enumerators, and respondents, for their cooperation throughout the study.

References Références Referencias

1. Arnoldus, H. M. J., Predicting soil losses due to sheet and rill erosion, FAO Conservation Guide 1, Guidelines for Watershed Management, FAO, Rome, Italy. 1977.
2. Assefa, A., 2011. Community based Watershed Development for Climate Change Adaptation in Choke Mountain: the case of Upper Muga Watershed in East Gojjam of Ethiopia.
3. Balci, N. Soil Conservation, Istanbul University Faculty of Forestry, Department of Watershed Management, University Publication No: 3947, Faculty Publication No: 439, ISBN 975- 404-423-6, Istanbul, Turkey. 1996 (in Turkish).
4. Belay, S. Building Resilience to Climate Change and Green Economy in Mountain Ecosystems of Ethiopia. Integrating Research, Capacity Building and Sustainable Development Activities. In Proceedings of the Stakeholders Workshop, Debre Markos, Ethiopia, 10– 13 June, 2011.
5. Belay, S. The Sustainability of Community-Based Adaptation in the Choke Mountain Watersheds, Blue Nile Highlands, Ethiopia. Proceedings of the 3rd World Sustainability Forum, online, Switzerland, 1–30 November, 2013.
6. Berendse, F., van Ruijven, J., Jongejans, E., and Keesstra, S. Loss of Plant Species Diversity Reduces Soil Erosion Resistance, Ecosystems, 18, 881–888, doi:10.1007/s10021-0159869- 6, 2015.

7. Bernard, R., 2006. Research methods in anthropology: Qualitative and quantitative approaches. USA. Alta Mira Press. 4th Ed. pp. 463-522.
8. Beskow, S., Mello, C.R. and Norton, L. D. Soil erosion prediction in the Grande River Basin, Brazil using distributed modeling. Catena, v. 79, p. 49-59, 2009.
9. Brevik, E. C., Cerdà, A., Mataix-Solera, J., Pereg, L., Quinton, J. N., Six, J., and Van Oost, K.: The interdisciplinary nature of soil, Soil, 1, 117–129, doi: 10.5194/soil-1-117-2015, 2015.
10. Cardinale, B. J., Duff, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., Narwani, A., Mace, G. M., Tilman, D., Wardle, D. A., Kinzig, A. P., Daily, G. C., Loreau, M., Grace, J. B., Larigauderie, A., Srivastava, D. S., and Naeem, S.: Biodiversity loss and its impact on humanity, Nature, 486, 59–67, 2012.
11. Cochran, W., 1977. Sampling Techniques, 3rd ed. John Wiley and sons. USA.
12. Eswaran, H., R. Lal and P.F. Reich, 2001. Land Degradation: An overview. In: Bridges, E.M., .D, Hannam, and L.R. Oldeman, F.W.T penign de vries, S.J. Scherr, and S.Sompat panit eds.).Responses to land Degradation. Proc. 2nd international conference on land degradation and desertification, Khon Kaen, Thailand. Oxford Press, New Delhi, India.
13. Eweg, H. & Van Lammeren, R, 1996. The application of a geographical information system at the rehabilitation of degraded and degrading areas. A case study in the highlands of Tigray, Ethiopia. Centre for Geographical Information Processing, Agricultural University Wageningen.
14. Gete, Z., Menale, K, Pender J and Mahmud Y, 2006. Stakeholder Analysis for Sustainable Land Management (SLM) in Ethiopia: Assessment of Opportunities, Strategic.
15. Giménez Morera, A., Ruiz Sinoga, J. D. Y., and Cerdà, A. The impact of cotton geotextiles on soil and water losses in Mediterranean rainfed agricultural land, Land Degrad. Dev., 21, 210– 217, doi:10.1002/ldr.971, 2010. 23
16. Haile, G. W. and Fetene, M. Assessment of soil erosion hazard in Kilie catchment, East Shoa, Ethiopia, Land Degrad. Dev., 23, 293–306. 2015. list Arnoldus, H. M., 1981. An approximation of the rainfall factor in the USLE. In M. de Boodt, & D. Gabriels (Eds.), Assessment of erosion (pp. 127–132). Chichester: Wiley.
17. Hawando, T., 1997. Desertification in Ethiopian highlands. Norwegian Church AID, Ethiopia, Rala report no. 200. Pp 75-86.
18. Hurni, H., 1985. Erosion—productivity—conservation systems in Ethiopia. In: Proceedings 4th international conference on soil conservation, Maracay, Venezuela, pp 654–674
19. Hurni, H., 1990. Degradation and conservation of soil resources in the Ethiopian highlands. Mt Res Dev 8:123–130
20. Hurni, H., 1993. Land degradation, famine and land resource scenarios in Ethiopia: World Soil Erosion and Conservation, edited by: Pimentel, D., Cambridge University Press, Cambridge, UK. pp 27-61.
21. Hurni, H., Abate, S., Bantider, A., Debele, B., Ludi5, E., Portner, B., Yitaferu, B., Zeleke, G., 2010. Analyzing degradation and rehabilitation for sustainable land management in the highlands of Ethiopia. L. Degrad. Dev. 9, 529–542. doi:10.13140/2.1.3976.5449
22. Lal, R., 1981. Deforestation of tropical rainforest and hydrological problems, in: Tropical Agricultural Hydrology, edited by:
23. Lal, R. and Russell, E. W., J. Wiley and Sons, Chichester, UK, 131–140. Lal, R., 2015. Restoring Soil Quality to Mitigate Soil Degradation, Sustainability, 7, 5875–5895, doi: 10.3390/su 7055875.
24. Meaza, 2015. The role of community based watershed management for climate change adaptation. International Journal of Weather, Climate Change and Conservation Research Vol.1, No.1, pp. 11-35, march 2015. Published by European Centre for Research Training and Development UK (www.eajournals.org)
25. Mekonnen, M., Keesstra, S. D., Stroosnijder, L., Baartman, J. E. M., and Maroulis, J.: Soil conservation through sediment trapping: a review, Land Degrade. Dev., 26, 544–556, doi:10.1002/ldr.2308, 2014.
26. Mekuria, W. , Langan , S., Noble, A., Johnston, R., 2017. Soil Restoration after seven years of exclosures management in north western Ethiopia. Land degradation and Development 28:1287-1297.
27. Ozsoy, G., Aksoy, E., Dirim, M. S.; Tumsavas, Z. Determination of soil erosion risk in the Mustafakemalpasa River Basin, Turkey, using the Revised Universal Soil Loss Equation, Geographic Information System, and Remote Sensing. Environmental Management, v. 50, p. 679-694., 2012.
28. Pretty, J. and Ward, H., 2001. Social capital and environment. World Development, 29(2): 209227.
29. Project Development Facility, 2007. Strategic Investment Programme for Sustainable Land Management in Sub-Saharan Africa: Assessment of the Barriers and Bottlenecks to Scaling-up sustainable land management investments throughout Sub Saharan Africa. Revised Draft.

30. Renard, K. G., Foster, G. R., Weesies, G. A., McCool, D. K.; Yoder, D. C. Predicting soil erosion by water: a guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE). Agriculture Handbook No. 703. Washington, DC: United States Department of Agriculture, 1997. 24
31. Stone, R.P. – Hilborn, d., 2000. Universal soil loss equation (usle). Series: factsheet no. 00-001 agdex 572/751. Agricultural engineering, ministry of agriculture, food and rural affairs, ontario. May 2000.
32. Tesfahunegn, G. B.: Soil quality indicators response to land use andsoil management systems in northern Ethiopia's catchment, Land Degrad. Dev., doi:10.1002/ldr.2245, 2013.
33. Wildemeersch, J. C. J., Timmerman, E., Mazijn, B., Sabiou, M., Ibro, G., Garba, M., and Cornelis, W.: Assessing the constraints to adopt water and soil conservation techniques in tillaberi, Niger, Land Degrad. Dev., 26, 491–501, doi:10.1002/ldr.2252, 2015.
34. Wischmeier, W.H., Johnson, C.B.& Cross, B.V., 1971. A soil erodibility monograph for farmland and construction sites. Journal Soil and Water Conservation, 26,189-193.
35. Wishmeier, W.H., and D.D. Smith. 1978. Predicting rainfall erosion losses: a guide to conservation planning. USDA Agricultural handbook.
36. Worku, 2016. Challenges of land degradation and its management: the case of Misirak Badawacho woreda of hadiya zone, SNNPR, Ethiopia
37. Yazdani, M., Monavari, S. M., Omrani, G. A., Shariat, M., and Hosseini, S. M.: Landfill site suitability assessment by means of geographic information system analysis, Solid Earth, 6, 945–956, doi:10.5194/se-6-945-2015, 2015.