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Impacts of Adopting Sustainable Land Management Practices on the Livelihoods of Smallholder Farmers : The Case of Benishangul Gumuz Region, Ethiopia

Mahammad Arega[1] Daniel Temesgen[2] J. Paul Mansingh[2]
1.Assosa University
2.Ambo University, Institute of cooperatives and development studies

Abstract
Land degradation has been identified as one of the most serious problems that threaten the sustainability of agriculture. In an effort to address these problems, the basic paradigm and approach to soil and water conservation has itself evolved over time. In recent years more holistic and land-scape wide approaches that go beyond resource conservation towards improved land husbandry and water management for beneficial conservation have been promoted using a national guideline. Hence, the major concern of this study was impact of adoption of SLMP. To meet this objective a total of 156 sample households, consisting 78 Sustainable land management adopter and 78 non adopter/ non- participants, were randomly selected from three kebeles in sample district. Descriptive statistics with appropriate statistical tests, and propensity score matching (PSM) were used to meet the stated objective. Descriptive statistical analyses such as mean, standard deviation and percentage were used to analyses basic household characteristics and the. Estimates of propensity score matching (PSM) indicate the existence of significant crop production increment on average 2.5 quintal production increment per hectare in each household head that were participated in adoption of sustainable land management practice value premium compared to non-adopter. The result indicated that Sustainable land management is crucial in improving the livelihoods of the farm households. However, to realize the intended outcomes, solving the fragmented nature of land holding, motivating development agent, rewarding model farmers require immediate attention.
Keywords: Sustainable land management, Propensity Score Matching, livelihoods

Background of the study

Land degradation is an environmental problem that reduces the productivity of all natural ecosystems and agriculture, which threatens the livelihoods (Dai *et al*., 2015; Erkossa *et al*., 2015; Gessesse *et al*., 2015; Ochoa-Cueva *et al*., 2015; Taguas *et al*., 2015; Prosdocimi *et al*., 2016. The problem of land degradation received great attention in Ethiopia following the 1973/74 famine (Lundgren, 1993). The rate of soil loss from Ethiopia is estimated to be about 2 billion Mg year-1 (Woldeamlak & Sterk, 2003). Erratic and erosive rainfall, steep terrain, deforestation, inappropriate land use, land fragmentation, overgrazing and farmers' management practices are among the factors that cause land degradation in the country (Osman &Sauerborn, 2001). Soil degradation is a major threat for agricultural yield it is also threat economic growth, incomes and consumption of primarily subsistence farmers. One way of controlling the adverse effect of soil degradation is adopting the SLM technology. It emphasizes on economically viable, socially acceptable and ecologically sound solutions, which could promote participatory land management practices to deal with land degradation. Sustainable land management (SLM) is crucial to minimizing land degradation, rehabilitating degraded areas and ensuring the optimal use of land resources for the benefits. The general objective of the study were to analyze the impacts of adoption of Sustainable land management practices on livelihood of farm households.

Research Methodology

The study Area is located in western Ethiopia with latitude and longitude of 104'0.120"′N 3431'59.880"′E, with an elevation of from 550 to 2,500 meters above sea level. The average annual temperature reaches from 20-250C. The annual minimum and maximum mean temperature 12.40^{C} and 27.80^{C} respectively. The annual rainfall amount ranges from 500-1800mm. The rainy season spreads through May to October.

Sampling Methods and Procedures

The study Woreda was purposively selected due to its accessibility and wide coverage of SLM Program. Purposive and simple random sampling technique was used to select sample kebeles and sample population respectively in the woreda. Purposive sampling technique was used to select sample rural kebeles. The sample frame of the study was the entire household participating SLM and non-participant in the three sample kebeles. The sample size from each kebele was determined using probability proportional to size sampling technique.

Sample Size and Sampling Frame
The sample size was determined using a simplified formula provided by Yamane (1967), as follows

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size or total household heads (1435) and e is the level of precision (.08).
When this formula is applied, we will get the following:

$$n = \frac{1435}{1+1435\,(.08)\,2}$$ n=156

For this study mixed approach was used which is both quantitative and qualitative methods. For quantitative study Cross sectional survey was conducted.
Table: 2 Creswell's framework for Research Design

Research Approach	Research Questions	Sampling Method	Tools
Mixed approach	-Sustainable land management practices adopted -impacts of adoption of Sustainable land management practices	Purposive & Simple Random Sampling	-Household cross sectional Survey -Key informant interview -FGD -Field observation

Data Collection
Both qualitative and quantitative from primary and secondary sources were used. The quantitative method involves house hold survey, while qualitative method comprises focus group discussion, key informant interview and observation. Primary data was collected from households, key informants. Interview schedule and checklist are used as a tool. Qualitative data were collected through FGD and through Key informant interview whereas quantitative data were collected through structured interview.

Data analysis
Qualitative data was analyzed through Content analysis. The descriptive statistics, inferential and econometric model were used to analyze quantitative data. Descriptive statistics like mean, percentages, standard deviation t-test for continuous and chi^2 test were used.

Propensity Score Matching (PSM) model
Propensity Score Matching is one of the most commonly used methods to evaluate the impact of program when there is a lack of baseline survey and random assignment of treatments to subject is not feasible. PSM refers to the pairing of treatment and control groups with similar values on the propensity score, and possibly other covariates (Rubin, 2001). Recently PSM has become one of the popular models used to evaluate the impact of different development interventions. The basic idea of the propensity score matching method (PSM) is to match program participants (SLM adopters) with nonparticipants (SLM non-adopters). But matching in terms of covariates, the exogenous variables, is very difficult since it is very difficult to find plots which are exactly the same but different only on receiving of SLM adoption (Menal et al, 2008). To solve this problem the matching process is done in the probability of participating in the program on the basis of observable characteristics (Menal et al, 2008). It means PSM constructs a statistical comparison group of adopters and non-adopters of SLM based on the propensity score of adoption of SLM. The reliability of matching estimates depends on three factors. First, treatment and control households should have the same distribution of observed and unobserved characteristics. Second, the same data collection tool should be administered to both treatment and control groups. Third; both groups should be selected from the same economic environment or community. If those three conditions are not fulfilled the difference in mean impact of the two groups is biased estimate of the mean impact of the program (Jalan and Ravallion, 1999). In case of binary treatment of the program the treatment indicator D_i equals one if individual i receives treatment and $Zero$ otherwise. The potential outcomes are then defined as:
$Yi(Di)$ For each individual i, where $i = 1, 2, \ldots\ldots n$, then the treatment effect of individual i can be expressed as:

$$Ti = Yi(1) - Yi(0) \quad (1)$$

This is used only to evaluate potential observable outcomes for each individual and leads to counterfactual

problems since other unobservable individual's characteristics which known as counterfactual outcomes are there; hence, estimating individual treatment effect Ti is not possible. Therefore, Average (population) treatment effect on the treated (ATT) is developed which specified as:

$$T_{ATT} = E(T|D = 1) = E[Y(1)|D = 1] - E[Y(0)|D = 1] \quad (2)$$

Therefore, the counterfactual mean for those being treated represented as:

$-E[Y(0)|\ D = 1]$That is actually not observed

$$ATT = E[Y(1)|D = 1] - E[Y(0)|D = 0] = T_{ATT} + E[Y(0)|D = 1] - E[Y(0)|D = 0] \quad (3)$$

T_{ATT} Is so-called 'self-selection bias' then the true parameters of T_{ATT} is only identified if

$$E[Y(0)|D = 1] - E[Y(0)|D = 0] = 0 \quad (4)$$

$$T_{ATT} = E[Y(1) - Y(0)] \quad (5)$$

$$(overlap) \qquad 0 < p(D = 1|X) < 1 \quad (6)$$

$$T_{ATT} = Ep(x)\ |\ D = 1\{E[Y(1)|D = 1, p(x)] - E[Y(0)|D = 0, p(x)]\} \quad (7)$$

To put this in words, the PSM estimator is simply the mean difference in outcomes over the common support; appropriate weighted by the propensity score distribution of participants.

Result and Discussion

Impacts of adopting SLM practices on production and income increment

In the case of production increment after adoption of SLM practices 67% of the respondents replied that production was increased after adoption of SLM practices whereas the remaining 33% of the respondents replied production was not increased because even though the fertility of soil were increased they were not cultivating the conserved land. In relation to crop income 70.5% of adopters' crop income has been increased and 18% and 11.5% was remain the same and decreased respectively whereas 47.5%, 32% and 20.5% of non-adopters crop income was decreased, remain the same and increased respectively. Similarly the livestock income of adopter was increased like their crop income in this regard 50% of adopters livestock income has been increased followed by 41% remain the same and 9% decreased whereas 45% of non-adopters livestock income has been remain the same followed by 29.4% decreased their livestock income and 25.6% of respondents livestock income has been increased.

Table: 2. Impacts of adoption of SLM practices

Items		**Frequency**		**Percentage**		**chi-2**	**p-value**
		Adopter	Non-Adopter	Adopters	Non-Adopter		
Production increment after adoption of SLMT	Yes=1	52	-	66.7			
	No=0	26	-	33.3			
	Total	78	-	100			
Crop income	Decreased	9	37	11.5	47.5	0.037	0.982 NS
	Increased	55	16	70.5	20.5		
	Unchanged	14	25	18	32		
	Total	156		100	100		
Livestock Income	Decreased	7	23	9	29.4	0.97	0.616 NS
	Increased	39	20	50	25.6		
	Unchanged	32	35	41	45		
	Total			100	100		
Total	156						

With regard to the impacts of SLM practices the FDG and key informant interview also confirm that soil erosion is highly reduced and the production that households produce from conserved land like sorghum and Teff is increased and households' are able to get good product. On the conserved land the fertilizer and the manure used is able to maintained and permanently settled because of the conservation.

Households' are also able to find wood and grass for construction materials around their home but, before adoption the SLM practice households' were forced to move more than 15 km by foot for search of construction but now a day households are able to find construction material every were especially on communal land. The other advantage is that by nature this bamboo trees have the advantage of increasing soil fertility because it have different layer, this enable the soil to recover its fertility within a short period of time. The previous degraded and deteriorated lands are able to produce good product. The manure and the fertilizer we used in our land is able to settle and it is not moved by flooding in contrary to pre intervention as a result it able to produce sufficient product not only for consumption but also for sell. Spring and ground water has increased and farmers are using this new spring for irrigation purpose and they are producing sufficient amount of vegetable. These increase their

income, food security status of their family and service transporting their product and vegetable produced through irrigation with the increments of spring and ground water.

Impact of Adopting Sustainable Land Management practices on Livelihood

Propensity scores matching (PSM) was employed to estimate the outcome variables in comparing participant and non-participant household in adoption of SLM practices. Thus, the estimated propensity scores of the logistic regression help to match the two groups of households i.e. adopter and non-adopter. Cognized this fact, the logistic estimation results, adopter and non-adopter were compared using outcome indicators: production outcome. To check how robust and sensitive our estimates four different matching algorithms have been estimated and results were found to be similar finding among them, which shows the robustness of the results. The three different matching algorithms have been used to estimate the impact of adoption of sustainable land management on rural livelihood using production as an outcome variable. The three matching algorism were; Nearest Neighbor, Radius and Kernel. The Average treatment effect on the treated (ATT) estimation results of each of the matching algorithms for production of the households are presented below in table 2.

Adoption of sustainable land management practices has an impact on rural household production and livelihood among adopter and non-non-adopters. The difference between the treated and control groups was easy to estimate using ATT. The treated group was those household heads who are participated in adoption of sustainable land management practices whereas control group were those household heads who are not adopting sustainable land management practices. The estimation results of the three algorithms is presented in table 4.9.and revealed that, there was significant difference production of households heads who are adopting sustainable land management practices and households heads who are not adopted of sustainable land management practices.

In setting the common support conditions the minima and maxima comparison was made. The basic criterion for determining the common support is to delete all observations whose propensity score is smaller than the minimum of adopters and larger than the maximum in the opposite group. The estimated propensity scores as shown in Table 6 vary between 4 and 9 quintal per household (mean = 6.44) quintals for program participants households and between 2 and 7 quintal per household (mean = 5.167) quintals for non-adopter households. Therefore our common support region would then lie between households who produce .08 and .99. As a result of this restriction, 14 non-adopters or control households) were dropped from the analysis in estimating the average treatment effect.

Table: 3. Distribution of estimated propensity scores

Groups	Obs.	Mean	Min	Max
All households'	147	5.801282	2	9
Adopters	78	6.435897	4	9
Non- Adopters	69	5.166667	2	7

Source: Survey result, 2018

Most of the adopter households have propensity score around 0.6 whereas a significant majority of the non-adopter households have propensity score less than 0.2. Thus it is possible to conclude from the above finding that adoption of Sustainable land management practices have a positive effect on households' production. Adoption of SLM had declined the value of crop productivity by about 16% for Nearest Neighbor matching (NNM) which is significant at 1% level of significance and 3.5% for Radius Matching (RM) which is significant at 10% level of significance, on average compared to the non-adopters.

Table: 4 ATT results for production of households

Matching Algorithm	Treated group	Control group	ATT	Std. Err	t- value
Nearest Neighbor	78	69	2.545	0.261	9.737*
Kernel	78	69	2.545	0.223	11.424*
Radius	78	69	2.545	0.243	10.471*

Source: Own Survey result, 2018

NB: * are statistically significant at 10%, probability level of significance

The main goal in using propensity score matching was to identify the average treatment effect on the treated plots (ATT). In the utilization of PSM in the study, the researcher first estimate a logit regression in which the dependent variable equals one if the household adopted SLM practice, zero otherwise and then check the balancing properties of the propensity scores. The balancing procedure tests whether or not adopters and non-adopters observations have the same distribution of propensity scores.

According to the above result, adoption of sustainable land management practices has a significant impact on households' production and livelihood security because all the three estimated results of the matching algorithm are statistically significant at 10% level of significant in all the three algorithm. As a result, the estimated ATT result of Nearest Neighbor, Kernel and Radius matching methods is 2.545 quintal production increment per hectare in each household head that are participated in adoption of SLM practices. This indicates

that there is difference in production, level of food security and strength of livelihood between adopter and non-adopter in which adopter are producing more and their food security status and livelihood strength are higher than their counter part non-adopter.

This finding contradict with the finding of (Masila *et al.* 2015) conducted in Kenya that adoption of Sustainable land management alone do not necessarily positively influence household food security and rural livelihood. Frequent and prolonged rainfall failures and poor agronomic practices are some of the important factors that deny farmers the full benefits of Sustainable land management practices.

Conclusions

Despite contribution of SLM practices on the livelihoods, the emphasis given to maximize its adoption in the study area is low compared to other rural development initiatives. Even though the country's Rural Development Policy and Strategy is thought to be relying up on proper utilization of land and labor together with proper management of natural resources in general and SLM in particular. Lack of information and knowledge is considered the major obstacles for facilitating the adoption of SLM among smallholder farmers.

The current study identified Adopters and non-adopter of SLM, and analyzed the impact of the adoption on the livelihood. Appropriate strategies are required to facilitate adoption of sustainable land management practices. Moreover, understanding of personal, socio-economic, institutional and biophysical factors that contribute crucial in identifying the appropriate SLM practices to be adopted. The finding revealed that majority of households are not adopted of sustainable land management practices because of different reason. Generally however, households' adopted SLM practices are able to produce more and diversified their livelihood and enhanced their food security status. Regarding the income of adopters versus non-adopters, the mean incomes of the two has shown significant difference. This suggests that households who have adopted sustainable land management practices are in better-off position to improve their livelihood than those who have not adopted. As the former can diversify and be able to afford SLM practices expenses, synthetic fertilizers, improved seeds, keeping livestock and thus uphold their livelihood sustainable. Therefore, the adoption of sustainable land management practices offer opportunities of improving the quality of the resource poor farmers. The adoption of SLM practices are constrained by highly fragmented nature of land holding system, migration, absence of motivated and committed development agent, lack of awareness and wield fire. So in order to fully adopt sustainable land management practices therefore, the above mentioned problem need to be addressed in the future.

Reference

Abera,Birhanu (2003). Factors influencing the adoption of soil conservation practices in north- western Ethiopia. M.Sc. Thesis, Institute of Rural development, University of Gottingen, Germany.

Aberha, E. T. (2008). Erosion and soil and water conservation group and environmental Policy group. Continue use of soil and water conservation practices. A Case Study in TullaDistrict, Ethiopia. Dissertation for Award of MSc Degree at Wagenigen University, Netherlands', 57pp.

Adebayo, O.&Olagunju, K. (2015). Impact of agricultural innovation on improved livelihood and productivity outcomes among smallholder farmers in rural Nigeria. Retrieved from http://web2.msm.nl/RePEc/msm/wpaper/MSM-WP2015-07.pdf

Adimassu, Z., Mekonnen, K., Yirga, C., and Kessler, A. (2014).: Effect ofsoil bunds on runoff, soil and nutrient losses, and crop yield in the central highlands of Ethiopia, Land Degrade. Dev.25, 554–564, doi:10.1002/ldr.2182, Agricultural development in the Ethiopian highlands', American Journal of Agricultural Economics, 83(5):1231-1240.

Ajala, B. A. (2001). Adoption of soil conservation practices in Oyo State. Dissertation for Award of MSc Degree at University of Ibadan, Nigeria: 145pp.

Alemu Mekonnen (undated) Erosion Control in Agricultural Areas: An Ethiopian Perspective, GTZ-Integrated Food Security Program Ethiopia

Antoci A., Russu P., Ticci, E. (2009). Distributive impact of structural change: Does environmental degradation matter? Structural Change and Economic Dynamics.

Arslan, A., McCarthy, N., Liper, L., Arsfaw, S., &Cattaneo, A. (2013) Adoption and Intensity of Adoption of conservation Framing Practices in Zambia. ESA Working Paper No. 13-01. Retrieved fromhttp://www.fao.org/3/a-aq288e.pdf

Asefa DT, Oba G, Weladji RB, Colman JE (2003) An assessment of restoration of biodiversity in degraded high mountain grazing lands in northern Ethiopia. Land Degradation and Development, 14(1):25-38

Assan, K. J., Caminade, C., & Obeng, F. (2009). Environmental Variability and Vulnerable Livelihoods: Minimizing Risk and Maximizing Opportunities for Poverty Alleviation. Department of Agricultural Economics University of Liverpool, 21, 403-418.

Awotide, B. A., Diagne, A., &Omonona, B. T. (2012). Impact of improved agricultural practices adoption on

sustainable rice productivity and rural farmers' welfare in Nigeria: A Local Average Treatment Effect(LATE) technique. Paper presented at the African Economic Conference, Oct. 30-Nov. 2.

Baudron, F., Mwanza, M. H., Triomphe, B., &Bwalya, M. (2007). Conservation Agriculture in Zambia: A casestudy of southern province. African Conservation Tillage Network. Retrieved from http://www.fao.org/ag/ca/doc/zambia_casestudy.pdf

Bayard, B., Jolly, C. M. and Dennis, A. S. (2006). The adoption and management of soil conservation practices in Haiti: The Case of Rock Walls. Agricultural Economics and Rural Sociology 7(2): 35 – 36.

Becker, S., Black, R. E., Brown, K. H. and Nahar, S. (1986). Relation between socio-economic status and morbidity, food intake and growth in young children in two villages in Bangladesh. Journal of Ecology of Food and Nutrition 18(5): 215 – 264.

Betru, N. (2002). Soil and Water conservation program in Amhara National Regional State. Paper presented at a Conference on Natural Resources Degradation and Environmental Protection in the Amhara National Regional State

Borlaug, N. (2007). Agricultural Development Initiative II: Increasing Small Scale Farmer Productivity through Improved Inputs and Management Systems. Muscle Shoals, Alabama, USA: 60pp.

Carla K, Arnaud M, Jacques M (2003) Spontaneous vegetation dynamics and restoration prospects for limestone quarries in Lebanon. Applied Vegetation Sciences, 6(2):199-204

Dai, Q., Liu, Z., Shao, H., and Yang, Z.: (2015) Karst bare slope soil erosion and soil quality: a simulation case study, Solid Earth, 6, 985– 995, doi: 10.5194/se-6-985-

De Graaff, J., Amsalu, A., Bodnar, F., Kessler, A., Posthumus, H., and Tenge, A. J. M. (2008). Factors influencing adoption and continued use of long-term soil and waterconservation measures in five developing countries. Applied Geography, in press.

Duveskog, D. (2001). Water harvesting and soil moisture retention. A study guide for Farmer Field Schools. Ministry of Agriculture and Farmesa, Sida, Nairobi

Eicher C. (1994). Zimbabwe's Green Revolution: Preconditions for replication in Africa. Staff Paper 94–1.Department of Agricultural Economics, Michigan State University, East Lansing, USA.

El Wakeel, A., and Abiye Astatke, (1996).Intensification of agriculture on Vertisols to minimize land degradation in parts of the Ethiopian highlands. Land Degradation and Development (UK) Vol. 7(1): 5-67.

Erkossa, T., Wudneh, A., Desalegn, B., and Taye, G.: (2015) Linking soil erosion to on-site financial cost: lessons from watersheds in the Blue Nile basin, Solid Earth, 6, 765–774, doi:10.5194/se-6-765-

Ervin, C. A. and Ervin, D. E. (1982). Factors affecting the use of soil conservation practices: Hypothesis, evidence and policy implications. Journal of Land Economics 58(3): 277-292.

Fisum Hagos, Pender J., and Nega G. (2002). Land Degradation and Strategies for Sustainable Management in Ethiopian Highlands: Tigray Region (second edition) Socio-economic and Policy Research Working Paper 25. ILRI. Nairobi, Kenya.

Gebregziabher G, Namara RE, Holden S. (2012). Technical efficiency of irrigated and rain-fed smallholder agriculture in Tigray, Ethiopia: a comparative stochastic frontier production function analysis. Quarterly Journal of International Agriculture 51(3): 203–226.

Gessesse, B., Bewket, W., and Bräuning, A.:(Undated) Model-based characterization and monitoring of runoff and soil erosion in response to land use/land cover changes in the Modjo watershed, Ethiopia,

Gomeje Amsalu. (2014). Opportunities, Challenges and prospect of community based natural resource management area: A case of menz-Guassa community conservation area.

Gilligan, D.O. and Hoddinott, J., (2007). Is there persistence in the impact of emergency? food aid? evidence on consumption, food security, and assets in rural Ethiopia.

American Journal of Agricultural Economics 89:225

Girmachew Siraw, (2005). Determinants of adoption of soil and water conservation practices: The case of Simen Mountain National Park. M.Sc. Thesis, Presented to the School of Graduate Studies of Alemaya University, Ethiopia Hans-Joachim, K.; Berhanu,F.; Yohannes,

Kajembe, G. C. (1994). Indiginous management system as a basic for community forest in Tanzania a case study of Dodoma urban and lusho to districts. Dissertation for Award of PhD at Wagenigen University of Agriculture, The Nertherlands. 194pp.

Katsuyuki, M.: Soil and humanity: Culture, civilization, livelihood and health, Soil Sci. Plant Nutr., 55, 603–615, doi:10.1111/j.1747-0765.2009.00401.x, (2009).

Kato, E., Ringler, C., Mahmud Y., and Bryan E., (2009) Soil and Water Conservation Technologies: A Buffer against Production Risk in the Face of Climate Change? Insights from the Nile Basin in Ethiopia, IFPRI Discussion Paper 00871

Kassie, M. Zikahli, M. P., Pender, J. and Kohlin, G. (2010). The economics of sustainable land management practices in the Ethiopian Highlands. Journal of Agricultural Economics 61(3): 605-627.

Krishana, R., Bishal, K., Ingrid, L. P. N. and Giridhari, S. P. (2008). Determinants of farmers adoption of

improved soil conservation practices in a middle mountain watershed of Central Nepal. Journal of Environmental Management 42: 210 – 222.

Hurni,H., 1994. Achieving sustainable soil Management in Agriculture. Pp. 25-26. In: SCRP Planning Workshop, 28 February-4 March,(1994), Nazreth, Ethiopia.

Hurni, H. 2000. Assessing Sustainable Land Management. Agriculture, Ecosystems Guidelines for development agents on soil conservation in Ethiopia.MOA, Addis Ababa.

Lundgren L. (1993). Twenty years of soil and water conservation in eastern Africa, RSCU, SIDA, Nairobi.

Masila, Maurice O. Udoto, James Obara, (2015)The Influence of Soil and Water Conservation Technologies on Household Food Security among Small- Scale Farmers in Kyuso Sub- County, Kitui County, Kenya published by Academia Publishing

Maxwell, S., & Smith, M. (1992). „Household food security: a conceptual review", in Maxwell, S. and Frankenberger, T. (ed.) Household food security: concepts, indicators, and measurements: A technical review. unicef and IFAD.

Ministry of Finance and Economic Development (MoFED) (2006) Ethiopia: Building on Progress A Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10) Volume I: Main Text, Addis Ababa

Moeyersons J (2006) Stone bunds for soil conservation in the northern Ethiopian highlands: Impacts on soil fertility and crop yield. Soil and Tillage Research, 90(1-2):1-15

Nill, D.,U., Schwertmadn,U., Sabel- Koschella, M., Berhard, and J., Brever, (1996). Soil erosion by water in Africa. Principles, prediction and protection. GTZ, Germany. 292pp.

Nkala, P. (2012). Assessment of conservation agriculture on farmers' livelihoods in three selected communities incentral Mozambique. Doctoral thesis submitted to the University of Natural Resources & Life Sciences,Vienna, Austria. Retrieved fromhttp://ir.nust.ac.zw/xmlui/handle/123456789/177

Ochoa-Cueva, P., Fries, A., Montesinos, P., Rodríguez-Díaz, J. A., and Boll, J.: (2015) Spatial estimation of soil erosion risk by land-cover change in the Andes of Southern Ecuador, Land Degrad. Dev., 26, 565–573, doi:10.1002/ldr.2219,

Osman M. &Sauerborn P. (2001). Soil and Water Conservation in Ethiopia: Experiences and Lessons. J Soils & Sediments 1 (2): 117–123.

Pender, J. G., Berhanu Gebremedhin, S., Benin, and S.,ehui, (2001). Strategies for sustainable development in the Ethiopian highlands. American Journal of Agricultural Economics. 83 (5):1231-40.

Pender, J. and B. Gebremedhin (2007), 'Determinants of Agricultural and Land Management

Prosdocimi, M., Cerdà, A., and Tarolli, P.: Soil water erosion on Mediterranean vineyards: A review, Catena, 141, 1–21, doi:10.1016/j.catena.2016.02.010, 2016.

Safene Chuma, AbayAyalew, Waga Mazengia and Tilahun Amede (2006), "Integrating various biological measures of erosion control and soil fertility management: The case of Gununo, Ethiopia.

Seleshi Bekele, and Daglus, J. Merry.(2007). Assessment of Small Scale Irrigation and water harvesting in Ethiopian: Agricultural Development /http://www.asareca.orgswment/Maputo /Maputo papers/ IWPdf

Senkondo, E. M. (2009). Land Degradation and Farmers' Adoption Conservation Technologies in Arusha. Sokoine University of Agriculture, Morogoro, Tanzania. 27pp.

Shibru Tefera. (2010). Land Degradation And Farmers' Perception: The Case Of Limo Woreda, Hadya Zone Of Snnpr, Ethiopia

Stanford Nkhoma, Thomson Kalinda1& Elias Kuntashula,(2017), Adoption and Impact of Conservation Agriculture on Smallholder Farmers' Crop Productivity and Income in Luapula Province, Zambia, Journal of Agricultural Science; Vol. 9, No. 9; 2017 ISSN 1916-9752 E-ISSN 1916-9760, 168-181

Stroosnijder, L. 2009. Modifying land management in order to improve efficiency of rainwater use in the African highlands. Soil and Tillage Research 103:247-256.

Tkilil Wolde and Sisay Mekonen,(2017) Assessment of factors affecting the adoption of soil and water conservation measures in assosa district benishangul gumuz region, Ethiopia, World journal of advance healthcare research. ISSN: XXXX-XXXX Volume: 1. Issue: 1: 25-40

Thomas Tolcha, (1991). Aspects of soil degradation and conservation measures in Agucho catchment, West Hararghe. Soil Conservation Research Project Report 19.University of Bern, Switzerland: 125.

UN technical Note No. 132, (1997). Guidelines and Manual on Land use Planning and Practices in Watershed Management and Disaster Reduction Economic and Social Commission for Asia and the Pacific. 19P.

Umar, B. B., &Nyanga, P. (2012). Conservation agriculture and rainfall variability in Zambia: Is CA apromising option for responding to droughts and floods. Department of International Environment andDevelopment Studies, Norwegian University, Norway. Retrieved from http://aciar.gov.au/files/node/13994/ca_zambia_umar_pdf_24091.pdf

Unger, W. Paul. (2006). Soil and Water conservation handbook. Policies, practices conditions and terms. Binghamton, : The Haworth Press.

World Bank. (2008). Sustainable Land Management Sourcebook: Agriculture and Rural Development, World Bank, Washington DC.

Woldeamlak Bewket (2002). Land Cover Dynamics since the 1950s in Chemoga watershed, Blue Nile Basin, Ethiopia. Mountain Research and Development 22(3): 263-269

Woubet G. Alemu1, Tadele Amare, BirruYitaferu, Yihenew G. Selassie1, Bettina Wolfgramm & Hans Hurni, (2013) Impacts of Soil and Water Conservation on Land Suitability to

Crops: The Case of Anjeni Watershed, Northwest Ethiopia. Journal of Agricultural Science; Vol. 5; ISSN 1916-9752 E-ISSN 1916-9760 Published by Canadian Center of Science and Education