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Impacts of integrated soil and water conservation measure on the livelihoods of rural Community in Selected Watersheds of Bambasi Woreda

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Abstract

Nowadays, most of the people in the world remain heavily dependent on soil resources as their main livelihood source, which leads to soil degradation. Soil erosion is a worldwide environmental problem that reduces the productivity of all natural ecosystems and agriculture, which threatens the lives of most smallholder farmers (Dai et al., 2015; Erkossa et al., 2015). Hence, the major concern of this study was to assess the impacts of integrated soil and water conservation measure on the livelihoods of small holder farmers in Selected Watersheds of Bambasi Woreda. To meet this objective a total of 356 sample households, consisting 178 soil and water conservation participant and 178 non-program participants, were randomly selected from seven kebeles of Bambasi districts (Amba16, Mender 45, Mender 46, Mender 47, Mender 48, Mender 49 and Sonka). Descriptive statistics with appropriate statistical tests, logit 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 types of technologies adopted by the farmers. Estimates of propensity score matching (PSM) indicate the existence of significant crop production increment on average 3.5 quintal production increment per hectare in each participated household head compared to non-participant. The result from the logistic model analysis revealed that participation soil and water conservation technologies was significantly influenced by variables such as severity of erosion, credit use, total land, access to media and soil fertility, distance from market and perception on soil erosion. Therefore, in agriculture dependent country like Ethiopia, soil and water conservation is crucial in improving the livelihoods of the rural farm households. However, to realize the intended outcomes, solving the fragmented nature of land holding, motivating development agent, rewarding model farmer and developing timely fire breaker require immediate attention.

Keywords: Soil and Water Conservation, Crop Production, Propensity Score Matching.

1. INTRODUCTION

The Ethiopian economy has its foundation in the agricultural sector. This sector continues to be a fundamental instrument for poverty alleviation, food security, and fueling economic growth. However, the sector continues to be undermined by land degradation in the form of depletion of soil organic matter, soil erosion, and lack of adequate plant-nutrient supply (Pender et al., 2007). As a result of this extensive land degradation, which in turn are caused by various intermingled factors, soil productivity has been negatively affected and agricultural production has not been able to meet the basic food requirements of the growing population. This has significantly contributed to the hunger faced by some five to seven million people in the country, thereby requiring external assistance every year for

their survival and more than 45% of the total population to toil below the absolute poverty line.

This loss of productivity directly affects the farmer's income, because more inputs are necessary to counteract these processes and to maintain long-term food production. It has also affected water supplies due to reduced infiltration. Exploitation of water resources for irrigation and other uses without creating favorable conditions for recharge leaves little or no water for ecosystem.

A serious consequence of land degradation is that the impacts from natural disasters are becoming increasingly more acute, in particular, vulnerability to drought and flooding (Bai et.al, 2006). Similarly, Bambasi Woreda has a potential of producing different agricultural products such as maize, mango sorghum and teff mainly for the home consumption and local market due to the availability of fertile soil, irrigation water and suitable climatic and topography of the land. But this untouched potential of the region has affected by different factors. Most of the farmers in the woreda clearly recognize that soil erosion is a serious problem affecting agricultural production. However, the introduced integrated soil and water conservation practice is technically, as well as economically complicated for farmers to construct and maintain and the technologies as being difficult to build and maintain, but they adopted the structures because of the seriousness of erosion (Tkilil Wolde and Sisay Mekonen, 2017). Thus, the central question is doing these integrated soil and water conservation interventions have an impact in improving crop production in value per hectare or not?

1.1. Statement of the Problem

The Ethiopian governments and different development agencies have invested substantial resources in promoting integrated soil and water conservation practices as part of efforts to improve environmental conditions and ensure sustainable and increased agricultural production. Despite the increasing efforts made and the growing policy interest, implementations of those integrated soil and water conservation technologies by smallholder farmers is not fully achieved. Regardless of all those efforts, the natural resource base is deteriorating from time to time and becomes major causes for food insecurity and vulnerability (Barrett, et al., 2002). In many parts of Ethiopia several kilometers of structural soil and water conservation measures were constructed on croplands. However, reports indicated that these conservation structures have not been sustainably used by the farmers (Fisumet al, 2002).

Yitayal Abebe and Adam Bekele (2014) soil and water conservation interventions may not result in significant improvement on crop productive and income and hence there is a need to critically evaluate such a program regularly.

Maguza-Tembo, F et al. (2016) concluded that adoption of soil and water conservation technologies did not improve the incomes of small-scale farmers. Similar to other parts of Ethiopia Benishangul Gumuz Region has invested millions of birr for integrated soil and conservation but, little impact studies on the livelihood the peoples have done. So the study filled this research gap by assessing the impacts of integrated conservation measure in Bambasi Wored. While there is a bulk of information regarding the adoption of SWC technologies little information is documented on the impact of the various long-term SWC measures implemented in the country in general, and in the study area in particular.

The assessment of the effectiveness of these technologies that are alleged to enhance farm productivity is very important in order to evaluate their performance in reducing land degradation. For farmers to make investment decisions in agricultural practice that will improve their welfare and livelihood there is a need to evaluate impacts between adopters and non-adopters of the technologies. Therefore this study was assessed the impacts of integrated conservation measure on the production capacity and livelihoods of small holder farmers in Bambasi Wored, where the

problem of land degradation and a number of intervention measures has taken place for several years.

1.2. Objectives of the Study

1.2.1. General Objectives

The general objective of the study was to assess the impacts of integrated soil and water conservation measure on the livelihoods of rural Community in Selected Watersheds of Bambasi Woreda

1.2.2. Specific objectives

1. To analysis the impacts of integrated SWC measure on the livelihoods of rural Community in the study area

2. To assess the role of institutional variables on farmers' participation in integrated conservation measure in bambasi woreda

1.2.3. Research Questions

The following research questions was developed to answer the impacts of integrated soil and water conservation measure on the livelihoods of small holder farmers in Selected Watersheds of Bambasi Woreda

2. Literature Review:

The concept of Livelihoods

The word „livelihoods" commonly means the way someone earns or means of living. A livelihood "comprises the assets (natural, human, financial, and social capital), the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base. Whereas, not all households are the same in their capacity to cope with stresses and repeated shocks, Maxwell and Smith (1992) argue that poor people balance contending needs for asset preservation, income generation to present and future food supplies in complex ways. Livelihoods Outcomes: Livelihood outcomes: these are the results attained from the livelihood strategies through the effective combination of the livelihood assets.

Categorization of Livelihood Activities: According to the livelihoods framework, livelihood activities are usually considered to generate an income. The categorization of livelihoods are income sources (Hussain et al, 2007), culminating in the following five categories: (i) paddy cultivation (rice crops), (ii) non-paddy cultivation (all non-rice crops including maize, vegetables), (iii) natural resource related livelihoods (incomes from fishing and cattle rearing), (iv) agricultural wages), and (v) all other non-farm livelihood activities (non-farm income from trade, self-employment and shop keeping). As explained in Hussain et al. (2007), in a rural setting in Sri Lanka, as is typical to the one in this study, households engage in multiple livelihood activities, (i.e., derive income from multiple sources that are both agricultural and non-agricultural). The institutional economic and environmental changes have an impact on the livelihood strategies of rural households in Northern Ghana, with their main source incomes from agricultural production. Although agriculture still represents the main economic activity in the area, survey data show an increasing diversification into nonfarm activities and migration (Assan et al. 2009). Livelihood is defined as the assets, the activities and the access that determine the living gained by the individual or household. Chambers and Conway (1992) define livelihood as the ways in which people satisfy their needs or gain a living. According to Ahmed and Lipton a livelihood should be seen as a set of flows of income, from hired employment, self-employment, remittances or (usually in developing rural areas) from a seasonally and annually variable combination of all these. They further stress that a livelihood should be able to assist those involved to avoid poverty, and preferably, increase well-being of the concerned person and his/her dependents.

Empirical Review on Impacts of SWC Measure on Rural Livelihood

Integrated soil and water land management program has a significant contribution in increasing crop productivity and hence, increase income to reduce food insecurity of smallholder farmers. A given intervention encompasses the spillover effects on production, income, environment, and on social welfare in general, and soil and water conservation measures have both on-site and off-site effects on society at large(Yenealem Kassa et al.2013) Nkhoma, et al,(2017) indicate that Conservation Agriculture is positively correlated with crop productivity. Nkala et al. (2012) found a positive correlation between CA and crop productivity and income in his study on the impact of CA on farmer livelihood in central Mozambique.

Awotide et al. (2012) equally found a positive impact of adoption of improved technology on sustainable productivity and farmers' welfare in Nigeria. Adebayo and Olagunju (2015) in their study in Nigeria also conclude that agricultural innovations such as CA have positive impact on farmers' livelihood. Baudron et al. (2007), in a case study in Southern Province of Zambia, observed that individual CA components (minimum tillage, permanent soil cover and diversified rotation) have specific effects in terms of improving soil fertility and enhance productivity. Umar etal. (2010) contends that CA, as opposed to conventional farming, can yield positive results in terms of productivity in Zambia if properly implemented. Arslan et al. (2013) also observes that adoption of CA tend to decrease yield variability in Zambia.

3. Methodology:

Descriptions of Study Area

Benishangul-Gumuz (BSG) is located in the north western part of the country created from the western most portion of Gojjamprovince (the part north of the Abay River), and the north-western portion of Welega Province (the part south of the Abay). Bambasi (also spelled Bambeshi) is one of the 20 woredas in the Benishangul-Gumuz Region of Ethiopia. Part of the Asosa Zone, it is bordered by the Mao-Komo special woreda on the southwest, Asosa in the northwest, Oda Buldigilu in the northeast, and by the Oromia Region in the southeast. This woreda and its only town, Bambasi, are named for the tallest point in this zone, Mount Bambasi. Rivers include the Dabus, which originates in this woreda.

Demographics

The 2007 national census reported a total population for this woreda of 48,694, of whom 24,720 were men and 23,974 were women; 9,146 or 18.78% of its population were urban dwellers. The majority of the inhabitants said they were Moslem, with 66.69% of the population reporting they observed this belief, while 29.26% of the population practised Ethiopian Orthodox Christianity, and 3.83% were Protestant.

Map of the study area

Figure: 1 *Map of the study area*

Source: SLMPII Report (2017)

Research Approach

For this study mixed approach will be used. Mixed methods is becoming increasingly articulated, attached to research practice, and recognized as the third major research approach or research paradigm. Mixed methods approach to research is an extension of rather than a replacement for the quantitative and qualitative approaches to research, as the latter two research approaches will continue to be useful and important. The purpose of the researcher using mixed methods is to draw from the strengths and minimize the weaknesses of the quantitative and qualitative research approaches.

Sampling Procedures and Techniques

Purposive and Simple random sampling procedures were applied to select Woreda and kebeles and draw samples for the study populations respectively. Bambasi Woreda was purposively selected due to its accessibility and wide coverage of integrated soil and water conservation program and related to its time of program implementation. Similarly, Purposive sampling technique was used to select sample rural kebeles. The sample frame of the study was the entire household both program participant and non-participant found in the five kebeles in which integrated soil and water conservation program is practicing. Accordingly the identified kebeles are Amba16, Mender 45, Mender 46, Mender 47, Mender 48, Mender 49 and Sonka. By using probability proportional to size sampling technique, the sample sizes from each kebele were determined.

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 (3184) and e is the level of precision (.05).

When this formula is applied, we will get the following:

$$n = \frac{3184}{1+3184(.05)2} n=356$$

Data Source

Primary Data Source and Collection Methods

The primary data was collected through both quantitative and qualitative methods of data collection. The primary data were collection through; interview schedule, key informant (KI) interviews field observation and focus group discussion (FGD). To collect the necessary quantitative data like information on different household's characteristics and the impact of the integrated SWC on the livelihoods of small holder farmers' interview schedule were designed. The schedule was pre-tested before conducting the actual data collection.

Secondary Data Sources and Collection Methods

Secondary data were collected from published and unpublished sources to supplement the primary data. Mainly secondary data for this study was collected by reviewing previous researches, publications from the Ministry of Agriculture on integrated SWC program implementation manual, reports and publication by different NGOs like SLMP and GIZ.

Methods of Data Analysis

Both descriptive statistics and econometric models were applied to analyze the empirical data of the study. The quantitative primary data were coded and entered in to STATA version 12 was analyzed quantitatively. The qualitative primary data gathered through KI interviews, FGD and personal observation methods was analyzed qualitatively through careful translation and narrating into text form. The descriptive statistics and econometric model tools are outlined and discussed as a below.

Propensity Score Matching (PSM) model

Propensity score matching method was used to assess the impact of integrated soil and water conservation practice on the livelihoods of small holder farmers. PSM 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.

Demographic Characteristics of the Respondents

Variable		frequency		percentage		chi-2	p-value
		Particpt	Non- Particpt	Particpt	Non- Particpt		
Sex of HH	Male=1	151	133	85	75	0.0550	0.815 NS
	Female=0	27	45	15	25		
	Total	178	78	100	100		
Educational Status	Illiterate=0	73	109	40	61	0.0257	0.873 NS
	Literate=1	105	69	60	39		
	Total	178	178	100	100		
Marital Status	Married	110	66	84	62	0.755	0.685 NS
	Divorce	30	2	3	17		
	Widow	38	10	13	21		
	Total	178	178	100	100		
Total		356					

Source: Own Survey result, 2019

4. RESULT AND DISCUSSION

4.1. Demographic Characteristics of the Respondents

As table 4.1.shows that about 85% of household heads were male and 15% were female headed household who participant in SWC practice where as 75% of the households head was male and the remaining 25% were female headed household in non participant categories. The figure shows that the number of female headed household was few compared to male in both adopter and non-adopter categories. But compared to participant, non participant constitute relatively high number which may indicate that sex of house holed determine participation of farmers on SWC measure. As illustrated in the above table 4.1 there was significant difference in educational status of participant and non participant that 40% and 60% of participant HH were illiterate and literate and 61% and 39% of non-participant HH was also illiterate and literate respectively. Thus majority of the participant HH were literate compared to non participant. From this we can generalize that when the educational status of the HH increase its probability to participate on SWC measure might also increase compared to non participant. In the case of marital status 84% of participant and 62% of non- participant were married and followed by 13% in participant HH and 21% in the case of non- participant were widow respectively and the remaining 3% of participant and 17% of non- participant was divorced. Thus in both adopter and non-adopter case majority of the respondents were married. There was no single (not married) in both adopter and non adopter case. Thus it indicates that married HH were relatively stable and have highly engaged in SWC measure.

Table 4.2 *Summery of Descriptive Table format for Continuous Variables*

Variable	Mean		S.D		Min		Max		t-test
	Participt	Non-Particip	Participt	Non-Participt	Participt	Non-Participt	Participt	Non-Partici	
Age of HH	54	55.6	8.8	9	31	40	72	75	0.72
HH Size	5	6	1.4	1.2	2	2	9	10	1.165
Fallow land	.5	.47	.3	.25	0	0	2	3	0.47
Cultivated land	1.07	1	.96	.47	.5	.5	5	8	2.24**
Nonfarm income	7306	6492	3325	3589	2000	2000	19000	25000	0.001***
Total	356								

Source: Own Survey result, 2019

NB: ***, **,*, are statistically significant at 1%, 5% and 10% probability level of significance respectively.

4.2. Descriptive Analysis of Continuous Variables

The average age of participant HH was 54 and non participant was 56 and the minimum and maximum age of participant were 31and 72 respectively where as the minimum and maximum age non participant were 40 and 75 respectively. In the study area the FDG finding also confirm that most of the farmers are getting old age as a result there is the problem of active labor force that can produce product from the conserved field were getting difficulties. Currently the past deteriorated land was able to produce teff, sorghum, maize and other local product through participation on SWC practice but, its continuation is under question mark because there is no interested young generation to work on agriculture. The average house holed size of participant was 5 and non- participant is 6 which indicate that there was no significant difference between the average house holed size of adopter and non-adopter.

The minimum and maximum house holed size of participant HH was 2&9 respectively whereas the minimum and maximum house holed size of non- participant were 2&10 respectively. This implies the household heads having small family size has positive effects on farmers' participation in SWC technologies practices.

The total farm size includes cultivated and fallow land. The average fallow land of participant HH were .5 and non- participant was .4 and the minimum and maximum fallow land of participant were 0 and 2 hectare respectively were as the minimum and maximum fallow land of non- participant was 0 and 3 hectare respectively.

The average cultivated land of participant HH were 1 and non- participant HH was also 1 and the minimum and maximum cultivated land of participant HH were .5 and 2 hectare respectively were as the minimum and maximum cultivated land of non- participant HH was .5 and 3 hectare respectively. The average income obtained from non-farm activity of participant HH was 7306 birr and it was 6492 birr for non participant HH and the minimum and maximum amount of birr obtained from non-farm activities for participant HH were 2, 000 and 19,000 and the minimum and maximum amount of birr obtained from non-farm activities for non-participant HH were 2000 and 2500 respectively. From this it is possible to generalize that participation in non-farm activity increase farmers participation using

additional income for implementation of SWC measure.

Descriptive Summary of Continuous Variables

Variable	Mean		S.D		Min		Max		t-test
	Participt	Non-Particip	Partic ipt	Non-Participt	Participt	Non-Participt	Partici pt	Non-Partici	
Age of HH	54	55.6	8.8	9	31	40	72	75	0.72
HH Size	5	6	1.4	1.2	2	2	9	10	1.165
Fallow land	.5	.47	.3	.25	0	0	2	3	0.47
Cultivated land	1.07	1	.96	.47	.5	.5	5	8	2.24**
Nonfarm income	7306	6492	3325	3589	2000	2000	19000	25000	0.001***
Total	356								

Source: Own Survey result, 2019

NB: ***, **,*, are statistically significant at 1%, 5% and 10% probability level of significance respectively.

Socio-Economic Variables

Variable		Frequency		percentage		chi-2	p-value
		Partici pt	Non-Participt	Adopters	Non-Participt		
Livestock holding	Decline	116	87	65	49	1.6212	0.203 NS
	Increased	49	60	28	34		
	unchanged	13	31	7	17		
	Total	78	78	100	100		
Livestock productivity	yes	153	69	86	39		
	No	25	109	14	61		
	Total	178	178	100	100		
Kinds of product	Maize& Sergom	38	36	21	22	7.66	0.264 NS
	Swabeen&chile	55	34	31	19		
	Teff	30	50	17	28		
	Maiz,sergom,teff, swabeen &chele	40	45	23	25		
	other	15	10	8	13		
	Total	178	178	100	100		

Participation in Non Farm activities	Yes=1	61	45	34	25	1.53	0.216 NS
	No=0	117	133	66	75		
	Total	178	178	100	100		
Types of non Farm	Petty Trade	18	8	29	18	2.13	0.712 NS
	Pottery	6	7	10	15		
	Charcoal selling	9	10	15	22		
	Sealing of wood	7	4	11	9		
	Labor hire out	12	4	20	9		
	Transport by Gary	9	12	15	27		
	Total	178	178	100	100		
Total		378					

Source: Own Survey result, 2019

NB: NS indicate not significant.

4.3. Interpretation of socio-Economic Variables

With regard to the livestock holding of the respondents, as can be seen in the above table 65% of participant HH and 49% of non participant HH are decline respectively whereas the remaining 28%of participant HH and 34% of non- participant HH are increased in their livestock holding and 7% and 17% remain constant in their livestock holding. But interims of livestock productivity about 86% of participant HH and 39%of non participant HH livestock productivity were increased were as 14%and 61% of participant and non participant HH livestock productivity were not which means participation on SWC measure have a positive impact on livestock productivity and when the number of livestock increased in a house holed livestock quality and productivity may decreased and vice versa.

With regard to the kinds of product produced locally majority or 31% of participant HH produce swabeen and chile and 28% of non-participant HH respondents produce teff whereas 23% and 25% of non participant HH produce Maize, Sorghum, teff, swabeen and chile followed by 21% participant HH and 22% of non adopter who were produce Maize and Sorghum. 19% of participant HH produce swabeen and chile whereas the remaining 8% participant HH and 13% non- participant HH produce other product. As illustrated in table 4.3 regarding to participation on non-farm activities, 34% of participant HH and 25% of non- participant HH were participated on non-farm activities and in both participant HH and non- participant HH case majority of the respondents were not participated on non-farm activities. So participation in nonfarm activity may have positive impact on practicing SWC measure.

Impacts of adoption of SWC measure on rural livelihoods

Items		Frequency		Percentage		chi-2	p-value
		Participant	Non-Participant	Participant	Non-Participant		
Production increment after adoption of SWCT	Yes=1	139	-	78			
	No=0	39	-	22			
	Total	178	-	100			
Crop income	Decreased	18	51	10	35	0.037	0.982 NS
	Increased	125	16	70	25		
	Unchanged	35	111	20	40		

Commercial crop	Total	178		100	100		
	Teff	28	49	16	28		
	Swaben&chil	130	88	73	49		
	Other	20	41	11	23		
	Total	178	178	100	100		
Commercial crop income 2011	Increased	115	77	65	43		
	Decreased	18	38	10	21		
	Unchanged	45	63	25	36		
	Total	178	178	100	100		
Use of commercial crop income	Save on bank	48	22	27	12		
	Purchasing livestock	70	54	39	30		
	Buying home at city	38	19	21	11		
	Other	22	83	13	47		
	Total	178	178	100	100		
Livestock Income	Decreased	31	71	17	40	0.97	0.616 NS
	Increased	99	45	56	25		
	Unchanged	48	62	27	35		
Milk production	Total	178	178	100	100		
	Increased	86	49	48	27		
	Decreased	24	75	14	43		
	Unchanged	68	54	38	30		
	Total	178	178	100	100		
Milk income	Increased	102	61	57	34		
	Decreased	25	69	14	39		
	Unchanged	51	48	29	27		
	Total	178	178	100	100		
Is resulted from SWC practice	Yes	122	-	69			
	No	56	-	31			
	Total	178	-	100			

Source: Own Survey result, 2019

4.4. Descriptive summery on impacts of adoption of SWC technologies

In the case of production increment after participant HH of SWC technologies practice 78% of the respondents replied that production was increased after participant HH of SWC technology practice where as the remaining 22% 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% of participant HH' crop income has been increased and 20% and 10% was remain the same and decreased respectively whereas 35%, 25% and 40 % of non-adopters crop income was increased, decreased and remain the same respectively.

Regarding commercial crop that the surveyed area 16% 73%and 11% of the respondent who were practicing SWC were produce teff, Teff Swaben&chile and other respectively whereas 28%, 49% and 23% of non participant HH was produce teff, Teff Swaben&chile and other. These indicate in both participant and non participant case majority of the respondents produce Swaben&chile as a source of income. This result also confirms the result which was found through FGD and KI that majority of them annually producing Swaben&chile for sealing. In relation to commercial crop income 65%, 10% and 25% of participant HH production level were increased, decreased and unchanged whereas 43%, 21% and 36% of non participant commercial production were increased, decreased and unchanged respectively. In both participant and non

participant case commercial crop productivity were increased this might be resulted from experience sharing from participant HH.

As in the table shown in terms of using income from soled commercial crop 27%39%, 21% and 13% of HH who were participated in SWC practice was save on bank, livestock perches buying home at city and other purpose respectively which means 87% of participant HH were directly or indirectly accumulating their asset annually and positively impacting their livelihoods. In the case of non participant HH 12%30%, 211% and 47% of HH who were not participated in SWC practice was save on bank, livestock perches buying home at city and other purpose respectively. Similarly the livestock income of participant HH was increased like their crop income in this regard 56% of participant HH livestock income has been increased followed by 27% remain the same and 17% decreased whereas 35% of non-adopters livestock income has been remain the same followed by 40% decreased their livestock income and 25.6% of respondents livestock income has been increased.

4.5. KI and FDG Result on the Impacts of integrated conservation measure on Rural livelihoods

It has been 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 SWC 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 specially 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 statues of their family and service utilization like Bajaj for transporting their product and vegetable produced through irrigation with the increments of spring and ground water.

Chambers and Conway (1992) define livelihoods as ―the capabilities, assets (stores, resources, claims, and access), and activities required for a means of living, meaning that a livelihood is sustainable if it can cope with and recover from stress and shocks, maintain and enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation‖. DFID (1999) also has a simplified sustainable livelihood framework that captures a broader concept of livelihoods that can be understood by qualitative and participatory analysis. The framework represents the linkages between vulnerability of the poor, performances in poverty reduction, and access to environmental assets in pursuit of beneficial livelihood outcomes that meet livelihood objectives at the local level within the spheres of social, institutional, and organizational environment (Figure 4). In addition, locally-driven solutions to livelihoods improvement are unattainable in the absence of direct and localized transfer of capital (human, natural, financial, social and physical), capacity-building, empowerment, and institutional reform at higher levels (WRI, 2008)

Table: 4.8. *Distribution of estimated propensity scores*

Groups	Obs.	Mean	Min	Max
All households'	340	8.14	4.5	16
Participant	178	9.4	6	20
Non-Participant	162	6.92	3	12

Source: Own Survey result, 2019

4.6. Descriptive Summery on the Estimated Propensity scores

The average production participant HH was 9.4 quintal per year whereas the average production non participant HH was 6.92 quintals annually which indicates that there is significance difference between participant and non participant in production that because of program participant HH were producing relatively high number of quintal compared to non participant. From this we can generalize that participation in SWC measure has significant impact on the production capacity of the farmers which leads to spent more on strengthen and diversifying their livelihoods through surplus production.

Table: 4.9. *ATT results for production and livelihoods of Small Holder farmers*

Matching Algorithm	Treated group	Control group	ATT	Std. Err	t- value
Nearest Neighbor	178	162	3.545	0.261	9.737*
Kernel	178	162	2.276	0.125	10.224*
Radius	178	162	2.545	0.258	9.879*

Source: Own Survey result, 2019

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

4.7. Interpretation of ATT results for production and livelihoods of Small Holder farmers

Most of the program participant households have propensity score around 0.6 whereas a significant majority of the non-program households have propensity score less than 0.2. Thus it is possible to conclude from the above finding that participation in adoption of soil and water conservation technologies practice has a positive effect on households' production. Adoption of SWC had increased 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.

According to the above result, adoption of soil and water conservation technologies in sustainable land management program has a significant impact on households' production and livelihood security in selective kebele of Bambasi Woreda 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 3.545 quintals Kernel 2.276 quintals and Radius matching methods is 2.545 quintal production increment per hectare in each household head that are participated in adoption of SWC technologies in sustainable land management program. 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 Soil and water conservation alone do not necessarily positively influence household food security and rural livelihood.

5. Conclusion

In doing so the study was covered assessing the impacts of integrated soil and water conservation measure on the livelihoods of small holder farmers in Selected Watersheds of Bambasi Woreda, Benishangul Gumuz Regional State of Ethiopia. A cross sectional primary data collected from 356 sample households (including 178 participant of soil and water conservation in sustainable land

management program and 178 non- participant was used for analysis in the study. The data collected through focus group discussion, key informant interview and field observation was analyzed qualitatively whereas data collected throgh interview schedule were analyzed quantitatively. In the study area majority of the household depends on mixed farming activities characterized by subsistence farming in which most of the farmer are producing only for consumption because the land is severely degraded, highly fragmented land holding system, their field is far from their village and crop failures exacerbate the problem combined with low adoption of soil and water conservation practice of the farmer.The three matching algorithms Nearest-Neighbor, Kernel, and Radius was used to estimate the impact of adoption of SWC technologies in sustainable land management program between treated and control groups. Those algorithms were used to estimate by the amount of production output measured in quintals of the household heads.

The matching algorithms estimation results show a positive and significant difference in production between the two groups of households (treated and control groups). The hypothesis of this study was adoption of SWC technologies in sustainable land management program has a positive impact on households' livelihood through production increment and household food security. Thus, the food insecurity occurrence in non-adopters households was greater than adopters' households. The result of the marching algorism implies that adoption of SWC technologies in sustainable land management program has an important influence on rural household production and consumption expenditure. This indicates that adoptions of SWC technologies plays a great role and positively contribute in strengthening the food security and livelihood status of the households'. As a result, household can sell the surplus product and spend expenditures for food and non food items via production income from adoption of SWC technologies as a result, livelihood security status of the household would increase simultaneously other things remain constant.

6. Recommendation

- Government can make a great contribution if priority to local level development is given allow local people to tap unused arable lands and water resources so that the degraded natural environments can be restored and protected, more food is produced by locals, livelihoods are diversified and, ultimately, vulnerable communities can lift themselves out from the bondage of poverty.

- There is a need for awareness-raising programs to give considerable attention to minimizing farmers' spending on expensive fertilizers that drains their household income, pollutes water resources, and destroys the natural components of soil.

- Emphasis must be given to enhance the capacity of innovative farmers and demonstration sites where the use of natural fertilizers

- The need for appropriate incentives to local officials and Development agent who are working in rural kebeles

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