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The role of watershed management for rural Livelihood Diversification in the case of Mariamshewito watershed, Ethiopia.

Meaza Hadush[1], Shalley Kapoor[2]

1. Dept.of geography, Adigrat University, Adigrat, Ethiopia. E-mail- meaziadu1@gmail.com, Mobil -+251914471720
2. M. J. P. Rohilkhand University, Bareilly, India.

ABSTRACT

Since 1980, the government was initiated watershed development to supported rural land rehabilitation, through well utilization and conservation of natural resource. *In line with this, the research has assessed the role of watershed management for Livelihood diversification in Adwa in the case of Mariamshewito Watershed. To address the above objective, the study used both qualitative and quantitative data type. In order to collect valuable information, semi structured questionnaire, focus group discussion, key informant guide checklist and observation tools from both primary and secondary data sources were applied. Similarly, different statistical methods such as percentage of frequencies, bar graphs, X^2 test, independent and paired sample T-Test and one way ANOVAs were used. The key finding of the research presents that due to different interventions the livelihood of the community was diversified, even if it has some gaps in the process of implementation such as lack of linkage between sectors, lack of targeting on the poor, young and women participation, weak stakeholder linkage. It is concluded that the watershed management can play a significant role to enhance household's livelihood Then, to fill the gap and go along the sustainability of the watershed, the study recommended based on the findings.*

Keywords: *Watershed Management, Livelihood, Diversification, Livelihood Diversification Index*

Background of the study

Ethiopia due to its geo-physical position and socio-economic context is highly prone to regular natural hazards and the impacts of climate change. Projected changes in rainfall and sea level rise and more extreme weather bring risks to the security of our water resources, agricultural systems and settlements, and to the health of people as well as animals (MOARD, 2005).

Watershed management productively used to bring back and preserve the agro-ecological feasibility and production potential of various watersheds throughout the world, using land-use management techniques that integrate across sectors and also address socio-economic concerns of local populations. Likewise, Watershed management is considered as risk management, chiefly related to landslides, storms and floods (FAO, 2006).

Few complete studies however, examined the extent to which Community Based Watershed management interventions have resulted in the desired effects (e.g.P Pathak and others, 2007, Assefa,2011). Impact studies have showed that investments in watershed management in the developing world do pay off in economic terms (e.g., Holden and others 2005). However, such impact studies do not typically include detailed socio-economical components. Similarly, watershed management in Eastern Tigray has grown in recent years from more technical interventions to restore degraded lands. Monitoring of such interventions is critical since existing evaluation techniques do not represent realistic and local specific scenario.

Objectives of the study

The objective of the research was to assess the watershed practices, household participation and its contribution for rural livelihood diversification.

Methods and Material

Description of the study Area

The scope of this paper has been limited to study the role of watershed management on climate change adaptation in Adwa, in the case of Mariamshewito watershed.

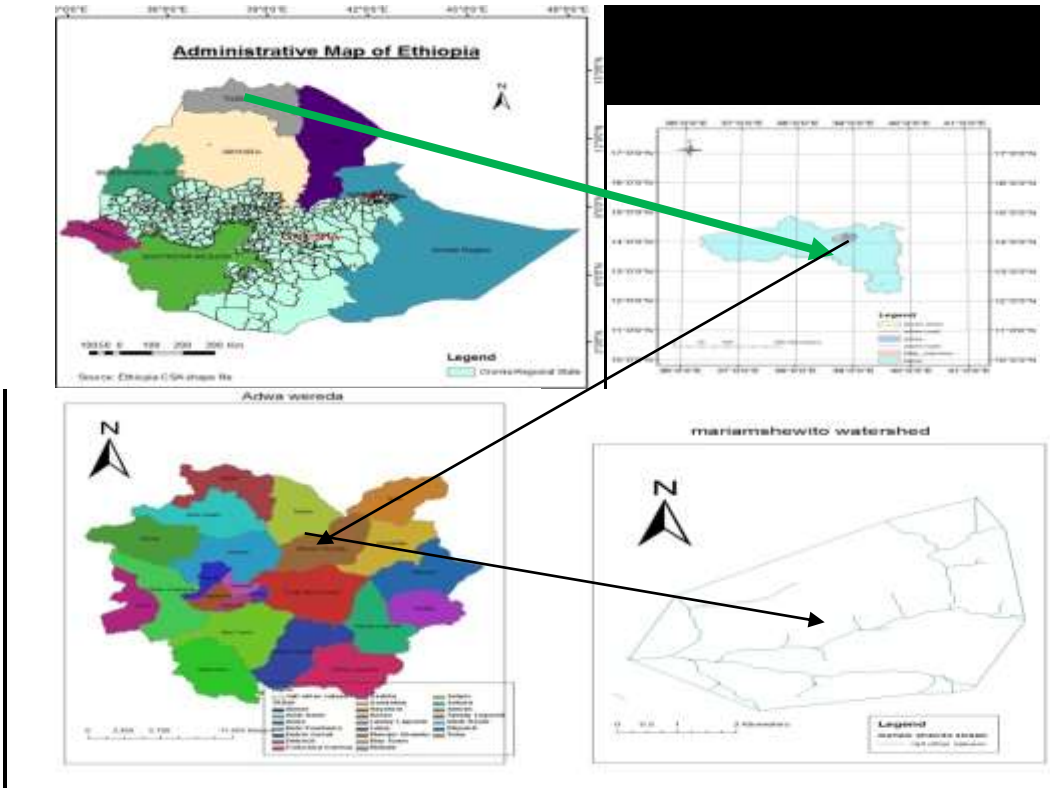

Fig.1. Map of the study area

Mariamshewito watershed is located in Adwa district, which is found in the Central Zone of the Tigray regional administration. Adwa is located some 1006kms away from Addis Ababa via Woldia-Mekelle road, in the extreme northern Ethiopia, within 14^0 15'N and 38^0 52'E geographically. Topographically, the woreda lies in midland with temperature 27, rainfall 600-850 and altitude 1890 m.a.s. The agro ecological zone of the woreda is Weina-dega (Midland), and qola 63% and37% respectively. These altitudinal agro ecological belts are generally accepted as having land use forms suitable for crop cultivation of barley, Wheat, pulses, teff,maize and sorghum, as well as horticulture production of vegetables and fruits in the vast riverside valleys of the fertile low lands (Adwa wereda Agricultural office, 2014) .

Research Design and sample frame

According to Dawson (2002) research design is the conceptual structure within which research would be conducted. Therefore, the researcher was used **cross sectional survey.** It assesses the overall activities at one shot.

Sample Frame

The sample frame of the study was peasant association list of households' roster.

Sampling Techniques and Sample Size

The study involved different sampling techniques. In order to select the study area and respondents for interview the researcher used purposive sampling method. Stratified sampling also used to categorize households to make comparative analyses among different groups in the community. First, categorical division is based on their wealth while the second extended category is within wealth category; there is also a need to address the gender balance in order to understand how both groups are contribute to and benefit from the management practices. After accomplishing the strata and having to the sampling frame, simple random sampling was implemented in each stratum to accomplish the whole process.

Sample Size

Care must be given to make the sample size of the study to be as representative as possible in accordance with the time and budget allocated. The rationale for deciding this sample size is based on factors like the homogeneity of population, cost of the survey, shortage of time, number of factors to be analyzed and the precision level required. The household number of the study area (mariamshewito kebele) is 1676, of which 1169 male, 507 female. Therefore, researcher was decided to select about 5% of each stratum that is 85. The sample size from each stratum was determined by using the disproportional sample selection.

Data Sources and Methods of Data Collection

The study was used both qualitative and quantitative data based on both primary and secondary data sources collected from different households, government offices and publications through survey, interview, Focus group discussion and reviewed documents. Besides, Maps and Satellite images were used to delineate the watershed using GIS tools.

Methods of Data Analysis and Presentation

Both quantitative and qualitative methods were used in analyzing the information collected using different instruments.

Qualitative data obtained using semi-structured questionnaire, interview, observations, FGD and document analysis were analyzed qualitatively using appropriate words. For quantitative data,

descriptive statistics such as mean, percentages and frequency were employed to analyze the data gather. This study also follows a kind of comparative analysis among the different gender and wealth of the sample households using IBM-SPSS 20 package program. Statistical tests and measures of variation were also used to analyze the involvement of different groups of the local community on the watershed management practices.

Results and Discussions

Watershed Management Practices in the Study Area

Since 1980, the government of Ethiopia was initiated watershed development to supported rural land rehabilitation, through well utilization and conservation natural resource (MOARD, 2005).

In Tigray, since the 1966, Farmers were familiar with traditional soil and water conservation practices in their day to day activities such as locally we call "Deret" that synonymous with 'grass strip' or 'soil bund'. But, their activities were not supported technically. However, currently technically supported physical and biological conservation measures were widely implemented to prevent soil erosion, land degradation and climatic hazards in the study area. The main purposes of mechanical/structural/physical soil and water conservation measures were to control the movement of water over the soil surface and limit its erosive capacity.

As the data from the farmers, the main physical conservation measures implemented in the study area were soil bund, deep trench, terraces, hill side terrace, haring bounce, half moon, gabion, gully cutting and stone bund.

Table 4.Types of physical soil and water conservations in the study area from 1997 -2005

Year	Type of SWC practices or activities										
	Stone bund in KM	Trench in KM	Trench bund	Hill side terraces in KM	Deep trench in KM	Bench terraces in M^3	Haring bonce in no	Half-moon in no	Eye borrow basin in no	Gabion	Gully cutting
1997	3	8	1	10.7	-	326	-	-	-	-	-
1998	11.26	15.4	1	17.58		4985	-	-	-	-	-
1999	16	29	17	11		2169	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-	-	-	-
2002	5.5	-	43.2	91.9	-	1063	4269	3229	-	-	-
2003	-	8.5	23	-	18.6	1464.5	-	8000	-	-	-
2004		17.0	28			1544		3009	2778	455	3250

Source: Natural resource development office, Adwa

Moreover, plantation of indigenous forest species is widely implemented in the study area. The number of indigenous forest species planted in the study area were increased from 8801 in 1996 to 344, 451 in 2004 and 65% of the area closure was cover by forest (Natural resource development office, Adwa, 2014).

Similarly, the various water harvesting structures constructed at mariamshewito watershed are check dam, shallow well, Shallow excavation for household consumption, river diversion, motor pumping, tanker(vaska), percolation diet and spring development(see table5).

Table5. Water harvesting structures in the study area

No	**Type of structure**	**No of structures**
1	Check dam	24
2	Shallow well	430
3	River diversion	9
4	Motor pumping	60
5	Spring development	6
6	Vasca(Tanker)	2
7	Percolation diet (Horeye)	624

Source: Water resource development office, Adwa, 2014.

Watershed management cannot be achieved without the willingness of local people to participate (Pretty and Ward, 2001 as cited in Tadesse). According to the survey and group discussants, most of the respondents were implemented the adaptation mechanisms, especially construction of soil bund and stone trace, compost preparation, community forest protection from deforestation, using fertilizer and improved seed, implementing cut and carry system, gully reshaping and land rehabilitation were implementing more than other activities.

Next, the researcher was needs to nullifying the hypothesis that the implementations of climate change adaptation mechanisms within the different groups of the community, age, education and gender differential in implementation of climate change adaptation mechanisms have been investigated using the independent T-Test. The independent T-test indicated that, P=0.000(t=4.3-

9.4, df=84) for all mentioned above variable has an implication of significance mean difference between the two groups.

Likewise, the analysis of the implementation of the above activities by different wealth groups indicates there is a significant difference among the wealth groups. The statistical analysis of the one way ANOVA shows that p=0.000-0.041 (F=3.3-21.4, DF=2) for all performances. In addition, to this the post hock analysis of most activities shows the significance difference is existed between the poor and medium and poor and better off. However, no significance difference between medium and better off. This indicates the acceptance of null hypothesis that is adaptation mechanisms are more implemented by the better-off and medium groups than the poor with large proportion difference.

Moreover, the analysis of the implementation of the above activities by different age groups indicates that there is a significant difference among the Age groups except for crop rotation and check dam construction. The statistical analysis of the one way ANOVA shows that p=0.001-0.038 (F=3.4-7.56, DF=2) for all activities except for crop rotation p=0.106 (F=2.309, DF=2) and check dam construction p=0.124 (F=2.144, DF=2) which indicates insignificant difference. Besides, to this the post hock analysis of most activities shows the significance difference is existed between the youngsters and Elders and Adult and Elders. However, no significance difference between Adult and youngsters. Adult and young households were more participated in the implementation than elder households.

From all the above discussion it is conclude that, even though different management practices implemented in the study area all households were not equally participated, especially women's and marginal farmers were less participant. eg, sex, educational status and wealth category.

Livelihood diversification

Surface and groundwater availability increased due to the various water storage structures and biological and physical soil conservation resulted in increased cropping intensity and helped household's to find new ways to raise incomes, reduce environmental risk and diversify their livelihood activity. Livelihood diversification index in this research is based on the Simpson index of diversity (Nicholas et al., 2006) modified by researcher in a way to fit for data available.

$\text{SID} = 1 - \sum_{n=1}^{n} \text{Pi}^2$ ~Where, Pi is proportionate contribution of i-th activity to income of household. In this research data available is regarding a number of livelihood activities that households practice. For this reason the proportionate is the inverse of the number of livelihood activities reported by a household heads.

$LDI = 1 - \frac{1}{\sum_{i=1}^{n} ki}$ LDI- Livelihood diversification index

Ki- is the number of livelihood activities practiced by household head the value of LDI always falls between 0 and 1. As the number of livelihood activities increases, the inverse of livelihood activities practiced by households' decreases so that LDI approaches to 1. Accordingly, households with most diversified incomes will have the largest diversification index, and the less diversified incomes are associated with the smallest index.

The livelihood diversity index for each household heads before and after watershed intervention is calculated to see the intervention effect. It indicates that livelihood diversification is the highest after watershed intervention than before.

Table1. Mean and Standard deviation of households' livelihood diversification before and after watershed management

Sex of household	Livelihood diversification before WM			Livelihood diversification after WM		
	Mean	N	Std. Deviation	Mean	N	Std. Deviation
Male	.6629	59	.7573	.7573	59	.07448
Female	.6458	26	.7004	.7004	26	.09910
Total	.6576	85	.7399	.7399	85	.08631

Source: Own computation from household survey, 2014

The mean livelihood diversification of household heads before and after watershed management was 0.66 and 0.74 respectively. The researcher was nullified the hypotheses that there is difference in livelihood diversification of households before and after watershed management using the paired sample T-Test.

Table2. Paired sample T-Test on livelihood diversification of households before and after watershed management.

Crop diversification	**Mean**	**Std. Deviation**	**t**	**df**	**Sig (2-tailed)**
before and after WM	-.08224	.06992	-10.843	84	.000

Source: Own computation from household survey, 2014

The test result indicates that there is a significant difference in livelihood diversification of households before and after watershed management. The livelihood diversifications of household's were higher after watershed management than before the intervention.

According to the group discussants and interview, the different soil and water conservation practices were contributes farmers to engage in different activities such as bee-keeping, trade due the access of credit and irrigation etc. Accordingly, the changes in livelihood diversification were accredited to the soil and water conservation practices and application of improved agricultural inputs.

Even though there were improvements in livelihood diversification, it is different within the different wealth status. The researcher nullified the hypothesis that, there is a difference in livelihood diversification among the different wealth groups using one way ANOVA (see table.3)

Table3. One way ANOVA analysis of livelihood diversification by wealth status

Crop diversification before and after watershed management with different wealth status		Sum of Squares	df	Mean Square	F	Sig.
crop diversification after watershed management	Between Groups	.247	2	.124	26.81	.000
	Within Groups	.378	82	.005		
	Total	.626	84			
crop diversification before WM	Between Groups	.440	2	.220	42.06	.000
	Within Groups	.429	82	.005		
	Total	.870	84			

Source: Own computation from household survey, 2014

The difference of mean before and after intervention between wealth status is statistically significant at, *p*=.000 (F=42.061, df =2) and p=.000(F=26.809, df=2) respectively. This indicates an overall significant mean difference in livelihood diversification by wealth status before and after intervention. Therefore, needs to look the pair wise (Post Hoc) mean difference between dependent variable contrasting to each wealth status (poor, medium and better off).

As given in table 4.10 a significant difference were obtained between all wealth groups, between better off and poor, better-off and medium(p= 0.000) and poor and medium (p= 0.001).

Table4. LSD Pair wise Post Hoc analysis livelihood diversification before and after intervention as dependant variable and wealth status as independent variable

Dependent Variable	(I) wealth status of household	(J) wealth status of household	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
crop diversification after watershed management	poor	medium	-.06536*	.01817	.001	-.1015	-.0292
		Better-off	-.13295*	.01817	.000	-.1691	-.0968
	medium	poor	.06536*	.01817	.001	.0292	.1015
		Better-off	-.06759*	.01784	.000	-.1031	-.0321
	Better-off	poor	.13295*	.01817	.000	.0968	.1691
		medium	.06759*	.01784	.000	.0321	.1031
crop diversification before WM	poor	medium	-.09802*	.01935	.000	-.1365	-.0595
		Better-off	-.17733*	.01935	.000	-.2158	-.1388
	medium	poor	.09802*	.01935	.000	.0595	.1365

	Better-off	-.07931*	.01900	.000	-.1171	-.0415
Better-off	poor	.17733*	.01935	.000	.1388	.2158
	medium	.07931*	.01900	.000	.0415	.1171

*. The mean difference is significant at the 0.05 level.

Source: Own computation from household survey, 2014

Likewise, livelihood diversification was also different within the different gender households. The mean livelihood diversification for male and female households was .66 and .64 before intervention and .75 and .70 after intervention respectively. The livelihood diversification for male and female were increased by .9 and .6 respectively. The increasing in livelihood diversification was higher for male household heads than female household heads.

Likewise, the researcher nullified the hypothesis that, there is a difference in the livelihood diversification by gender (see table5).

Table5. Independent T-Test analysis of fertilizer distribution by Gender group

Levene's Test for Equality of Variances between gender groups		t-test for Equality of Means								
		F	Sig.	t	df	Sig. (2-tailed	M D	SE D	95% CID Lower	Upper
crop diversification before WM	Equal variances assumed	.27	.60	.61	82	.540	.01475	.02	-.0329	.06
	Equal variances not assumed			.630	50.992	.531	.01475	.0234	-.0323	.0617
crop diversification after watershed management	Equal variances assumed	4.758	.032	2.91	82	.005	.05703	.0196	.0180	.0960
	Equal variances not assumed			2.62	38.423	.013	.05703	.0217	.0129	.1011

Source: Own computation from household survey, 2014

The independent T-test result shows that there is no significant difference in mean between the groups before intervention, p=.603. But difference is significant after intervention p=.032.

Therefore, even though all households' especially poor and female households were not benefited equally, the different watershed interventions enhanced the livelihood diversification of the household in the study area.

Conclusion

The government together with NGOs and local communities perform many activities in the study area to support the local communities to cope with climate change, such as; Physical soil and water conservation measures such as soil bund, deep trench, terraces, hill side terrace, check dams, and water diversions, compost preparation (organic fertilizer compost and manure), dissemination of chemical fertilizer, aforestation, area closure protection and management, water management (water harvesting and groundwater recharging structures such as check dam, Shallow excavation for house hold consumption and irrigation, percolation tank, spring development, irrigation practices, cut and carry system as discussed in the above.

Moreover, conserving and promoting of high yield local crop varieties, not only yield but also disease resistance, crop rotation, changing planting date, conserving indigenous forests species and awareness rising to conserve natural resources which enabled households to enhance their livelihood, even though households were participated in the implementation of the various climate change adaptation mechanisms all households were not equally participated, especially marginal and poor households were less participant.

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