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Indigenous and modern soil management practices and its determinant factors in Yayo district, Ilubabor zone Southwest Ethiopia

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Abstract
The main objective of this study was to investigate Combination level and Role of Indigenous and Modern Soil Conservation Practices in the case of Yayo District, Ilubabor zone, southwest Ethiopia. Cross-sectional research designs with both qualitative and quantitative research approaches were employed. Two stage sampling procedures with combination of purposive and simple random sampling procedures were used to select 210 sample household heads for the study. Household survey questionnaires, key informant interview, focus group discussion and field observation were used to collect the data. Binary logistic model was used to identify determinant factors of farmers' decision to adopt soil conservation practices. The finding of the study showed that contour plowing, farmyard manure and traditional cut-off drain were the most practiced indigenous soil conservation practices. Improved crop seed, use of chemical fertilizer and insecticide and pesticide were the major improved/modern/ soil conservation practiced performed by household of the study areas. Insubstantial level of integration between indigenous and modern soil conservation practices were another finding of the study. The result also indicated as decrease soil erosion, improve income, improve water availability, and increase crop & livestock productivity were to the major contributions of integrating indigenous and modern soil conservation practiced in the study area.. The result of binary logistic regression analysis showed as livestock ownership, distances to farm plot, access to credit services and extension services were significantly ($p<0.05$) affect household decisions to adopt soil conservation practices. Therefore, farmers should be adopting profitable and sustainable soil management practice and integrate indigenous with modern soil management practices.

Keywords
Determinant factors, Indigenous, modern, Soil conservation

Introduction

Studies indicate that of the total agricultural land of the country which is about 60 million hectare, around 45% is significantly eroded according to Food and Agricultural Organization of the United Nations (FAO, 2009). Agriculture is the main stay of the major proportion of human population of the country, even. though it is threatened by human induced degradation and climatic factors. Farmers have many indigenous practices in management of natural resources in their landscapes (Kibemo 2011). Soil conservation practice (SCP) promotes, participatory soil conservation practices and related soil conservation strategies. It includes a range of complementary measures adapted to the biophysical and socio-economic con-

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text for the protection, conservation and sustainable use of resources (e.g. soil, water and biodiversity) and the restoration or rehabilitation of degraded natural resources and their ecosystem functions. Unfavorable climatic conditions (e.g. those imposed by climate change and climate variability), coupled with the mismanagement or misuse of resources, can increase degradation and vulnerability to change. On the other hand, the adoption of favorable practices, such as selecting proper land uses (based on land suitability evaluation) and implementing (Soil Conservation Practices) SCP, will enhance sustainability and resilience in the face of change. Natural resource degradation has been a major environmental, socio-economic and policy problem in Ethiopia. The top soil of Ethiopia is undergoing at a faster rate of erosion. The rate of soil loss for Ethiopia varies considerably from place to place. Conservation measures on farmlands like construction of soil and stone bunds, terracing, fanayajuu, tree planting and cut-off drain on agricultural areas have been introduced. The knowledge of the Konso people in soil conservation is exceptional and considered as the best experience in the world (Yeshambel 2013). The study by (Dawit 2014) identified indigenous soil conservation practices includes fallowing, animal manure application, burning to prepare the field, cut of drain, termite mound destruction by flooding are among the indigenous land management practices. The same study also identified the contemporary soil management practices like grass strips, area closure, soil bund, check dam, contour tree planting, agro-forestry, compost and commercial fertilizers. Several studies have shown that limitation in the use of indigenous measures and lack of effective linkage between indigenous and modern ones have been identified as one of the major problems that hinder the effectiveness of the development of agriculture and the economy of the country in general (Yilkal, 2007). The indigenous soil conservation practices seek to harmonize with ecological benefits (minimizing soil loss and runoff, improving the fertility of the soil), economic benefits (sustaining and increasing production) and social benefits (preventing out-migration of land users to urban centers). However, some of indigenous soil conservation measures are ill-designed and may aggravate soil erosion unless they are linked with modern measures (Yilkal, 2007). Soil erosion can be halted if appropriate soil conservation measures are undertaken. However, the low adaption and the limited soil conservation technology results low soil conservation coverage. Hence, inadequate land protection and malpractices such as soil burning, nutrition depletion, overgrazing and others exposed the land to erosion (Mubarak 2014). Even though the government of Ethiopia promoted various SC practices, farmers could not implement practices and improve agricultural productivity (Asnake et al., 2017). The performances of SC practices are less effective and mostly undertaken in campaigns without the full participation of crop producers and livestock keepers. The adoption of soil conservation practices (indigenous or the contemporary) affected by several factors. According to (Aklilu 2006), the adoption of soil conservation practice is influenced by farmers' age, farm size, perceptions on technology profitability, slope, livestock size and soil fertility, and the decision to continue using the practice is influenced by actual technology profitability, slope, soil fertility, family size, farm size and participation in off-farm work. The study of (Mubarek 2014) revealed farmer adoption of SC determined by demographic, institutional, socio-economic and physical factors. The study of (Fikru 2009), have reported that sex of farmers is the critical factors influencing the efficacy of the farmers' decision to adopt soil conservation measures. (Fikru 2009) findings of study also, education of households head significantly and positively determined farmers' perception of soil conservation practices. Less attention has been paid to studying and understanding for how failure to integrated indigenous and modern SC practice affects the socio-economic of the local community. The above gap is also observed in the study areas with inadequate of research finding. Therefore, this study was attempt to find determinant factors of adoption of soil conservation practices in the study area and tries to recommend possible techniques for combining both SC practices. In addition, it helps farmers to have detail information about role of soil conservation practices in improving agricultural productivity in the study area. The general objective of the study is to investigate Indigenous and Modern Soil Conservation Practices and its determinants in Yayo district of Ilubabor zone Southwest Ethiopia.

Materials and research methodology

Description of the study area: Yayo District is one of the 14 District of Ilubabor Zone of Oromia National Regional States. Yayo is located in the southwest part of

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Ethiopia. It is located at 564 km from Addis Ababa. Astronomically, the district is located between $7^{0}52'34"$-$7^{0}58'21"$N and $38^{0}41'01"$- $38^{0}44'31"$E. Yayo shares boundaries with Chora district in the western part, Hurumu district in the Eastern part, Doreni district in the Southern part and Sigmo /Jimma/ in northern part

Drainage and climatic condition of the district major rivers like Geba, rivers floe throughout the year and the other rivers are Birbir, Gindib, Saki and Dogi Rivers are found in the district (Yayo District Agricultural Office 2021)..

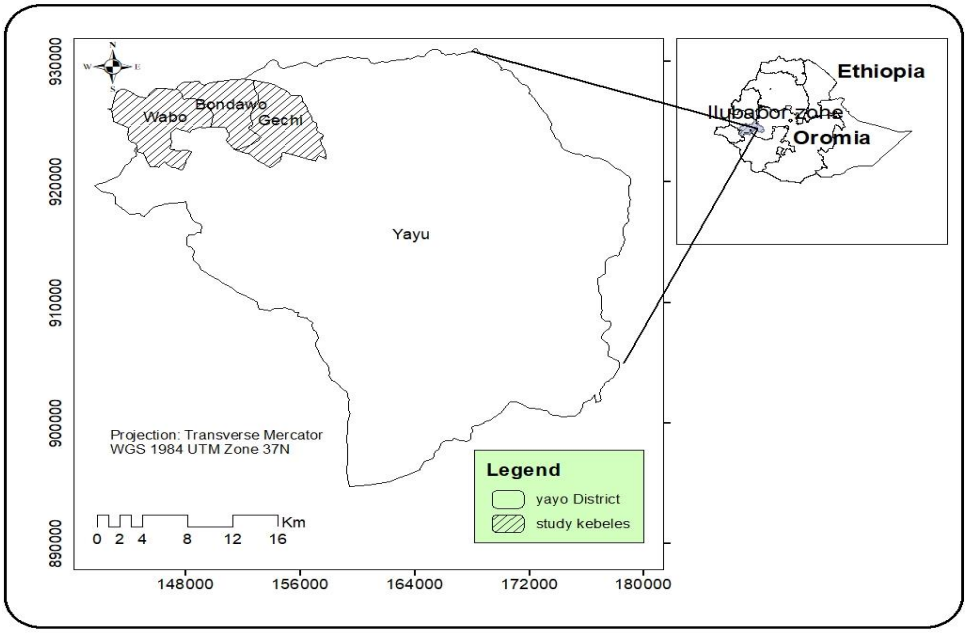

Figure 1
Location map of the study area

Research design and research approach: A good research design is the core for the final analysis of the research results. Under this study cross-sectional survey research design was employed to conduct the research, because it enables the researcher to scratch wide area of the problem in the study area. This study is designed to investigate the level of integration and effectiveness of indigenous and modern SC practice in Yayo District. The researcher used the combination of quantitative and qualitative research approach to conduct the study. Data source and types: This study was used both primary and secondary sources of information. Sampling techniques and sample size determination: This study area is selected for the research because it is the area where both indigenous and contemporary soil conservation practiced. Moreover, as far as, it is known to the researchers, no study has been carried out on the issue. The researcher applied both probability and non-probability sampling techniques to select the samples from the study area. Household survey respondents were selected through simple random sampling techniques while the selected kebeles, key informants and focus group discussion were through non probability sampling techniques. In order to determine the sample size, selection of sample frame was conducted. The sample frame of the study was three kebeles'; Bondawo-Gechi, Waabo and Gechi household in Yayo District of Ilubabor Zone. The selected study area is selected for the research because it is the area where agriculture activities widely practiced. Moreover, as far as, it is known to the researchers, no study has been carried out on the soil conservation practices in detailed in the study area. As suggested by (Kumar 1999) regarding the sample size, for survey study, 'such as this one' 10 to 20 per-

Table 1. *Proposed sample respondents in each sampled rural kebele*

Rural kebeles	Total households	Proposed sample of households
Bondawo-Gechi	420	63
Waabo	500	75
Gechi	480	72
Total	1400	210

Source: Yayo District Administration office (2022)

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cent of the accessible population is enough. Accordingly, in each of the study kebele, a sampling intensity of 15% of the total households was randomly selected for the household questionnaire survey (see Table 1). A lottery method was used for all of these random selections.

Methods of data collection

The study designed to carefully and adequately gather primary data through using of questionnaire, key informant interview, focus group discussion and field observation. Variables and model specification: In order to identify the determinant factors that affecting farmers' practices of soil conservation (SC), binary logistic regression model was used. In this case, the dependent variable is dichotomous (i.e. farmers' decision to practices or not to practices SC). The response variable was a binary variable, which was assigned a value of '1', if farmers adopt SC practices, and a value of '0' was assigned if a farmer not-adopt SC practices. Following Chatterjee and (Hadi 2006) approach, the binary logistic regression model for this study is defined as follows:

$$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + ...+\beta_{12}X_{12}+\epsilon \quad [1]$$

In this model Y is the dependent variable representing SC practices , X_1, X_2 + ... + X_{12} are explanatory variables of the model and ϵ is the random (or unexplained) part of the model.
The residual term ϵ is again assumed to be normally distributed with mean 0 value and variance σ^2.The unknown parameters β_o, β_1,...,β_{12} are called the regression coefficients. The explanatory variables used in the model were selected based on empirical literature dealing with SC.

Table 2
The summary of variables and their expected relationship with dependent variables

	Variables	Description & measurements	Expected sign
1.	Age	years	-ve
2.	Sex	1 if male otherwise 0	+ve
3.	Education level	1 if literate otherwise 0	+ve
4.	Land holding size	Ha	+ve
5.	Farm experience	Years	+ve
6.	Participation of household SC	1 Participation otherwise 0	+ve
7.	Farm land ownership	1 if farmer have an ownership	+ve
8.	Livestock ownership	TLU	+ve
9.	Annual income	Birr	+ ve
10.	Distance to farm plot	Kms	-ve
11.	Access to credit services	1 if accessed otherwise 0	+ve
12.	Access to extension services	1 if accessed otherwise 0	+ve

Methods of data analysis

For analysis, SPSS (Statistical Package for Social Science) version 23 software was employed and computations of descriptive statistic such as frequency and percentages were carried out. Binary logistic regression model was used to analyze the determinant factors that affecting farmers' practices of soil conservation (SC).

Results and Discussions

Existed indigenous soil conservation practices. According to the results of research conducted in Dejen District by Tegegne (2014) there are various soil conservation practices applied by farmers on their own farm plots. Study of Abera (2018) in Ofute Catchment, Southern Ethiopia showed as a number of indigenous soil management practices were practiced in the catchment such as fallowing, crop rotation, contour farming, traditional stone bunds, traditional ditches, plantations and traditional cut-off drains. According to Dawit (2014) the most widely implemented indigenous measures were traditional

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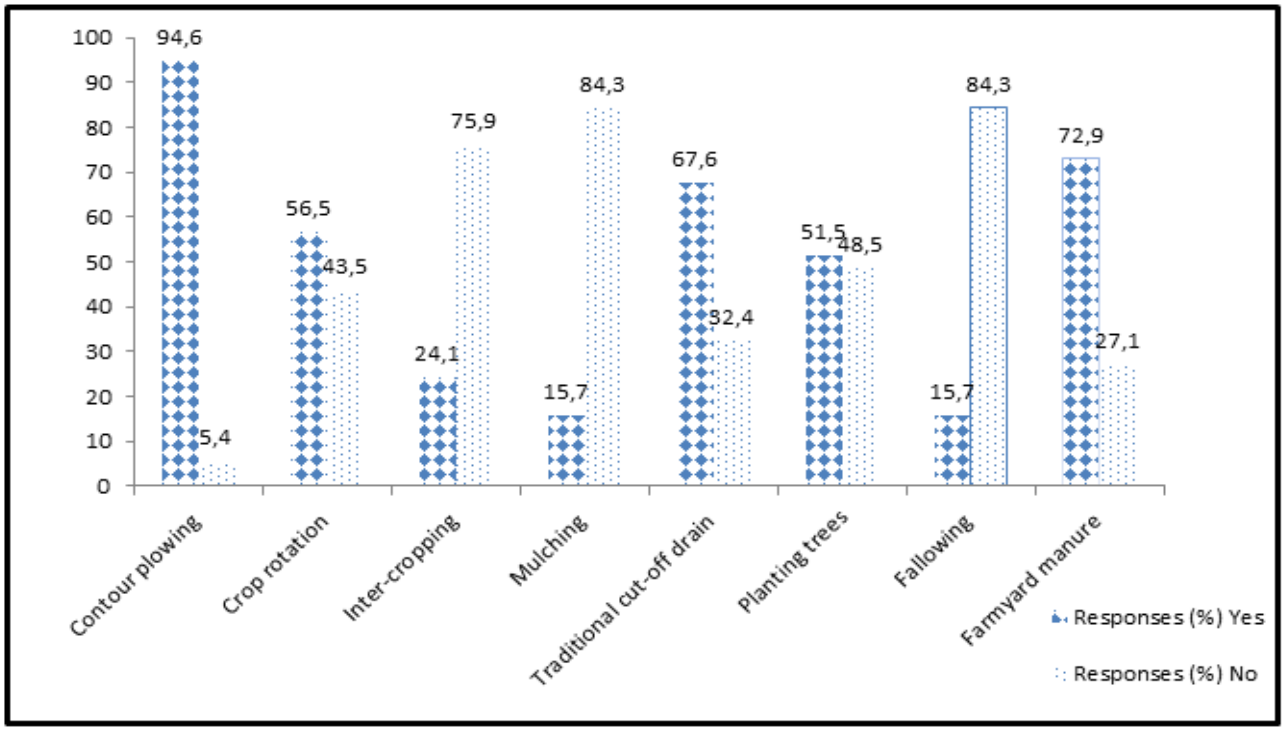

Figure 2. *Indigenous soil conservation practices.* Source: Field survey, 2022

waterway (97.9%) followed by furrow (85.5%), whereas the least implemented were check dam (48.9%) and uncultivated strip (51.1%). In several cases, farmers applied different methods of soil conservation. Cultivating crops on the contour where the slope was steep is one of them. During field visit, most of the farmers in the study area were used contour plowing, farmyard manure, traditional cut-off drain and crop rotation in order to minimize runoff and erosion.

Modern soil conservation practices of the Study Area

The introduced type of soil management technologies refers to the recommended type of structures, which have standard length, width and height. These structures have specific design requirements and need major investments of labor in construction, often during a single period. In most areas of Ethiopia, new land management technologies were introduced more than two decades ago. As it was observed from table 3 above 90.3% of the household in the study area were used inorganic fertilizer as modern soil conservation practices. What is generally noticeable here, according to farmers, is that productivity without chemical fertilizers is not imaginable, but can be more effective if chemical fertilizers and organic fertilizers are combined together.

In the study area, compost is prepared from animal manures, plant leaves as well as crop residues. However, the largest proportion of the inputs comes from animal manures. While activities like area closure, agroforestry and soil bunds were among the least types of modern soil managements practiced by household of the study area. As shown on the above table the use of agro forestry for soil conservation is not widely practiced activity in the area (8.4%).

Table 3. *Modern soil conservation practices*

Modern soil conservation practices	Responses%	
	Yes	No
Improved crop seed	93	7
Application of Inorganic Fertilizer	90.3	9.7
Compost	40.1	59.9
Area closure	11.4	88.6
Pesticides & insecticide	55.2	44.8
Agroforestry	8.4	91.6
Soil bund	17.7	82.3

Source: Field survey, 2022

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The role of integrating indigenous with modern soil conservation practices: Proper soil management practices can generate both private and public benefits by addressing poverty and food insecurity as well as environmental issues. In terms of private benefits it increases and conserving natural capital including soil organic matter, various forms of biodiversity, water resources and increasing crop production and source of fuel wood(Pender, 2006). In regarding to public benefits they maintain environmental sustainability. As shown on the above table the contribution of integrating the indigenous and modern soil conservation practices were identified. More than 90% of respondent household said as integrating of indigenous with improved had different contributions.

All of the respondents agreed upon as undertaking both conservation mechanisms resulted in the improvement of their income. It also shows that adopters can be able to afford expensive synthetic fertilizers, improved seeds, keeping livestock and thus uphold their livelihood sustainable. Integrating the indigenous with the improved technology had also a great role in increasing crop & livestock productivity, reducing soil erosion and forest cover enhancements in the study areas. According to discussion with KII and FGD integrating of both techniques together have a paramount significance in the study area. Similar with the above survey result KIIs and FGDs made with household also reveals improving household income, increasing the productivity of crop & livestock production, and lessening soil erosion loss were stated.

Contribution of integration of indigenous and modern soil conservation practices	Responses%	
	Yes	No
Decrease soil erosion	90.6	9.4
Improve income	93.3	6.7
Improve water availability	100	
Increase crop & livestock productivity	83.6	16.4
Forest cover recover	94.3	5.7

Table 4
Contribution of integration of indigenous and modern soil conservation practices
Source: Field survey, 2022

Determinant factors of combination of soil conservation practices: Farmers' practice of SC measures could possibly be influenced by different factors. The binary logistic regression was used to identify major factors that determine household head to adopt soil conservation. The dependent variables were analyzed with twelve explanatory variables. A statistically significant fitted model ($\chi 2$= 102.39, p = 0.000), suggesting that the model had strong explanatory power. The Nagelkerke R Square value shows that about 71% of the variations in the adoption of soil conservation were explained by the explanatory variables considered in the study. As can be seen from the result of binary logistic regression analysis age, educational status, land holding size, farm experience, livestock ownership, distances to farm plot, access to credit services and extension services were significant and affect household decisions to adopt soil conservation. The binary logistic regression result depicts that household heads gender had positive and significant with household adoption of soil conservation at (B=1.03, P=.000*). The binary logistic regression result illustrates that household heads sex had its own impact on the adoption of SC practices and statistically positive and insignificant at (B=.461, P= .123). The Wald statistics (2.37) indicated that female household heads were limited participating in the adoption of SC practices relatively to males. In other word, male household heads were engaged in the adoption of SC practices by the factor of odd-ratio (1.58) than women. The binary logistic regression result also confirm that, there is a significance relationship between educational status and adoption of SC practices (B=.369, P=0.037). Education can increase farmers' management capacity and understanding of the newly introduced SC measures. It is expected that those farmers with better educational attainment perceive the problem better and make decision to retain conservation structures (Habtamu, 2006). The binary logistic regression analysis indicates that farm

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size has positive and significant relationship at 0.05 level of significance (B=1.278, P=0.042). The binary logistic regression model result indicates that livestock size is significant at 5% level of significant (B=.146, P=0.007). Regarding to distance of farmland from the residence of farmers, there is statistically positive significant with the adoption of SC practices (B=1.26, P=0.006). This means, farmers farmlands near to their residence have higher probability of adopting SC by a factor of 1.26 times greater than farmers with their farmlands are far from their residence.

Table 5
Result of binary logistic regression model

Variable	B	S.E.	Wald	Sig.	Exp(B)
Age	1.03	.045	.038	.000*	.912
Sex	.461	.299	2.376	.123	1.586
Educational status	.369	.312	1.396	.037*	1.446
Landholding size	1.278	1.40	6.026	.042*	.78
Farm experience	.421	.014	6.62	.003*	1.08
Participation level	1.93	.680	1.82	.051	.465
Farm land ownership	-2.82	3.13	.000	.999	.68
Livestock ownership	.146	.054	7.166	.007*	1.157
Annual income	.47	.007	4.32	.786	2.05
Distance to farm plot	1.26	.22	.387	.006*	1.81
Access to credit	.138	.322	.184	.008*	.871
Access to extension	.865	.376	5.294	.021*	.421
Constant	.584	.514	1.29	.256	1.79
Chi-square	102.39				
-2 Log likelihood	343.65				
Cox & Snell R Square	0.138				
Nagelkerke R Square	0.71				

Source: SPSS version 23 result output
*statistically significant at <0.05
** statistically significant at 0.001%

Access to credit services of the household head is hypothesized to have a significant ($p < 0.005$) and positive influence on the adoption of SC. The binary logistic regression analysis indicates that access to credit services were negative and insignificant relationship at 5% level of significant (B= 0.138, p= 0.668). Access to extension services had a positive significance at <0.05 level of significance (B=1.779, P <0.021) which is analogous to the hypothesis.

Conclusions and Recommendation

In the study area both indigenous and modern soil conservation practices were practiced. Contour plowing, farmyard manure and traditional cut-off drain were the most practiced types of indigenous soil conservation. Improved crop seed, use of chemical fertilizer and insecticide and pesticide were the major improved /modern / soil conservation practiced performed by household of the study areas. Indigenous practices like inter-cropping, mulching and fallowing and modern soil conservation practice like agroforestry, area closure and soil bund constructions were among the least soil conservation practiced identified by household farmers of the study areas. In comparing with indigenous and modern conservation practices, the indigenous mostly practiced in the area. The integration between contour plowing and improved seed, farm yard manure with agroforestry were the most observed while like crop rotation with compost and use of pest & insecticide were the smallest integration. According to KII most of the farmers of the study area more focus on the traditional soil conservation practices than the improved practices. It is clear that the integration of

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both practices have its own significance for different purposes. Farmers' practice of SC measures could possibly be influenced by different factors. The major factors include; age, educational status, farm experience, income, land holding size and access to extension services were identified. Integrating indigenous soil conservations with that of the modern/newly introduced soil conservation practice is very crucial for an improved livelihood and sustainable land use. Hence, soil conservation experts ought to be able to consider the preference of local farmers while planning and implementing measures. Agroforestry have various contributions in addition to soil conservation. While as shown in the discussion section the practices of agroforestry is not widely practiced activity in the area. Therefore farmers should adopt agroforestry as soil conservation practices in particular and for its multi contributions in general. The adoptions of SC practices in the study area were influenced by various factors. These, the district agricultural office should facilitate credit access to the households and strength the extension services through the DA regularly contact with farmers as much as possible.

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