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Research Article

Farmers' Participation in Watershed Management in Sodo Zuria District of Southern Ethiopia

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ABSTRACT

This examination aimed to survey the farmers' participation in watershed management and distinguish significant factors deciding the farmers' participation and cooperation in watershed management practices in the investigation territory. Descriptive statistics and econometric models were utilized for investigation purposes to meet the expressed targets. The sampled farmer families were classified low, medium, and highly dependent on their support score esteems the 4-8, 9-12, and 13-16 participation run separately. The farmers' participation in problem identification and decision making, planning and monitoring and evaluation is shallow in contrast with their participation in the execution level. The Ordered Logit Model outcome uncovered that among the 17 variables estimated to influence the farmers' participation in watershed management, 8 variables were measurably noteworthy with the speculated sign as determinants of farmers' participation in the watershed the executives. Consequently, the family size is positive and significantly influence the farmers' participation; dependency ratio negatively and significantly influences the farmers' participation; more dependency ratio diminishes time, work, and enthusiasm to partake in watershed management practices, education positive and fundamentally influence the farmers' participation, farm size is positive and significantly affect the farmers' participation, the distance of parcel of land from residence positive and altogether influence the farmers' participation, soil fertility positive and altogether influence the farmers' participation, extension contact positive and altogether influence the farmers' participation, farmers households who approach credit were found to have negative and fundamentally influence the farmers' participation.

RESEARCH ARTICLE

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- Participation index,
- Slope of land,
- Soil erosion,
- Watershed management practices

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INTRODUCTION

Ethiopia is one of the creating nations in which land assets are getting progressively scant, and the nature of assets, for example, soil water, plants, and creatures are diminishing because of misuse and management. Watershed degradation: land degradation as soil disintegration, sedimentation, depletion of soil supplements, deforestation, and overgrazing are essential issues confronting the farmers in Ethiopia. This restricts their capacity to increase agricultural production and decrease poverty and food insecurity (Temesgen, 2012).

To address the watershed degradation, the comprehensive watershed management practices were dispatched in Ethiopia, particularly after the starvation of the 1970s. Starting now and into the foreseeable future, immense regions have made sure about terraces, bunds, and a massive number of trees have been planted. Even though various watershed management techniques have acquainted with battle watershed degradation, the adoption of these practices stays underneath desires (Yeraswork, 1998).

Regardless of considerable advancement in watershed management in southern Ethiopia, watershed degradation is as yet proceeding. Watershed management is fundamental for monitoring water, land, and biodiversity, redesigning neighborhood jobs, improving the economy of the inhabitants' people.

The impact of watershed degradation is severe in the highlands of the country (areas that lie above 1500 m), which constitute less than half of the country (43 percent of the country). Because of its good atmosphere for production and presence of moderately more fertile soils just as less sickness rate, the Ethiopian high lands have about 88% of the national populace (FAO, 2000).

Watershed degradation especially erosion and the decrease in humus substance of soils lessen penetration limit of soils and soil moisture and storage capacity. This way, reduction in infiltration and moisture storage capacity of soils diminishes the limit of yields to withstand drought. Thus, manageable variations in rainfall become catastrophic events with watershed degradation. Many exploration concentrates in Ethiopia credited the chronic poverty, fundamental food insecurity and repeating starvation halfway to the natural catatropical damages finally (Woldeamlak, 2003).

Perceptive of these issues, watershed management practices have actualized in numerous pieces of the highlands during the 1970s and 1980s. They were introduced in some degraded and food insufficiency districts fundamentally through food-for-work motivating forces. The significant kinds of management practices introduced were essential, and the most notable was the bench terraces and ordinary bunds (Bekele, 2007).

The examination's overall goal was to assess the farmers' participation in watershed management in Sodo Zuria Woreda, Wolaita Zone. The study's specific targets were to look at the farmers' current status in the watershed management in the examination region and recognize the factors impacting the farmers' cooperation in watershed management in the assessment zone.

MATERIALS AND METHODS

In this investigation, to have a fair portrayal of the populace and catch a representative sample; a multi-stage sampling procedure has utilized to choose sample family units. Ethical Committee approval was obtained for the study.

In the main stage, out of the 12 rural woredas in Wolaita Zone, one Woreda (Sodo Zuria) and from 31 Kebeles of the Woreda, 3 Kebeles have picked purposively. In the second stage, 3 watersheds have selected from one from every 3 Kebeles by purposively. In the third stage, sampling frame (complete watershed farmer household lists) was obtained from each Kebele Administrative Office and then by using the Probability Proportional to Sample Size methods the sample households from each Kebele have selected according to the number of household in it. Finally, 90 respondents have drawn by using a systematic random sampling technique (Figure 1).

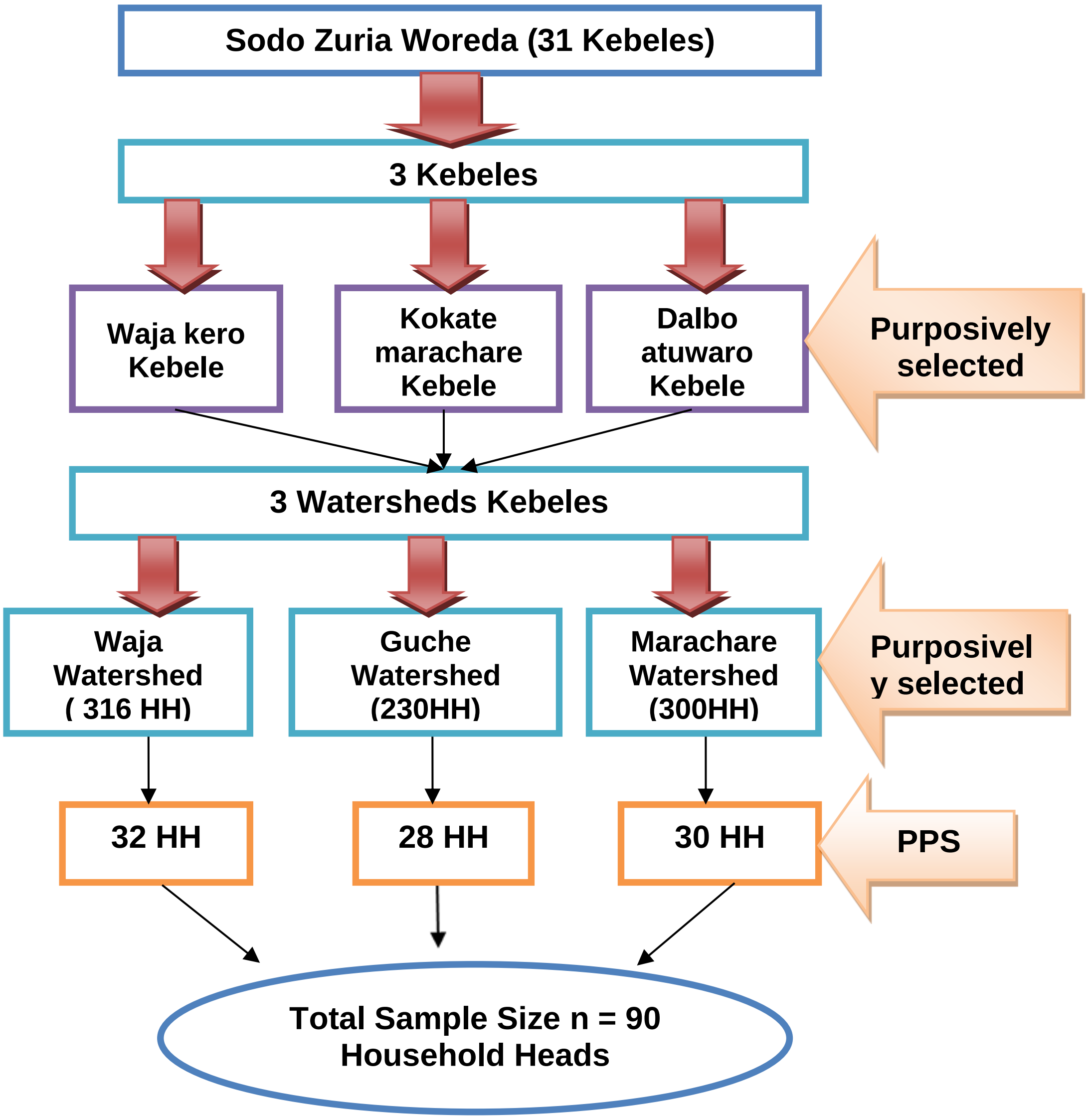

Figure 1. Random sampling technique.

Sample Size Determination

A significant choice that has made while choosing a sampling technique is about the size of the sample. Suitable example size relies upon different variables identifying with the subject under investigation, including time, cost, and precision level. When sample size is minimal; the goals of our research may not be tended to definitely. So proper sample size was applied to get a good representative data.

Because of its easiness work with the simplified formula for proportions suggested by Yamane (1970) has used to calculate the sample size. It assumes that a 90% confidence level, e is the error margin between (5-10) percent.

Assuming e = 10 %

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

Where n is the sample size, N is the Universe of the population size of 3 watersheds which have been 846 HHs, e is the extent of precision that assumes e = 0.10. When the formula has applied to the above sample, the sample size is necessary for the study has shown below as follows.

$$n = \frac{846}{1 + 846(0.10)^2} = 90$$

The farmers' participation in watershed management activities has estimated by putting the indicator exercises with their score assessment of frequencies.

The respondents have asked the amount they were sharing an interest in those exercises. This relies upon their intervention as Frequently, Occasionally, Seldom, and Never and the focuses have granted for each response with good scoring esteems as 4, 3, 2, and 1 independently. The repeat counts of reactions have recorded to handle the Participation Index (PI) of a farmer for all of them picked works out, so the index built by appointing equivalent loads to every reaction.

Table 1. Indicators to measure the farmers' participation and their given score values.

S. No.	Types of Indicators	Nature of Participation	Value Given
1	Problem Identification and Decision	Never	1
2	Planning	Seldom	2
3	Implementation	Occasionally	3
4	Monitoring and Evaluation	Rare	4

The respondent's score could be extended from 4 to 16, where 4 exhibits all the farmers are not participating in some random action and 16 shows the significant interest of all farmers in that development that infers all are frequently partaking (Tilahun, 2008).

The recurrence checks of responses have recorded to enlist the Participation Index (PI) of a farmer for all of them picked works out. By then the Participation Index for each activity has been figured by using the going with the equation;

Participation Index (PI) = (N1X4) + (N2X3) + (N3X2) + (N4X1) (1)

Where:
PI=Participation Index for different activities of Participation in the watershed management

N1 = Farmer who participate **Frequently**
N2 = Farmer who participate **Occasionally**
N3 = Farmer who participate **Seldom**
N4 = Farmer who **Never** Participate

To attain the first objective, this is "to analyze the current status of watershed management practice in the investigation area." the study employed participation index. The index has determined from important indicators of farmer Participation in watershed management found from the literature review. The scores of these exercises were resolved for each respondent and changed over them into critical record esteem a motivating force as Roman (2010) used a similar strategy to gauge the admittance to and use of family arranging information among country women and the strengthening status of the rural women by calculating the scores obtained from the different pointers.

So as to accomplish the second objective, "to recognize the factors that impact the farmers' support in watershed management in the examination region", ordered logit model has utilized. Since the Dependent variable accepts ordinal nature, the ordered logit is generally favoured when contrasted with different models.

The ordered logit model was used due to the arranged idea of the dependent variable. The usage of a reasonable model has commonly directed by the concept of the dependent variable or elements. In this examination, the dependent variable is categorical or ordered nature. At that point, the Ordered Linear Regression hasn't adequately given the variable's non-span nature, and the scattering of the outcome choices can't be uniform. Ordinal logit and probit models have been commonly used to look at such kinds of information (Liao, 1994).

Some polychotomous Dependent factors have unavoidably requested. Even though the outcome is discrete, the multinomial logit or probit models would disregard to speak to the ordinal idea of the Dependent variable (Greene, 2008). The arranged probit and logit models have come into wide use to separate such reactions (Zavoina and MacElvey, 1975). Accordingly, the Ordered Logit Model has used to overview the farmers' Participation's determinant having three particular classes. That is Low, Medium, and High support classes.

By following Greene (2008) and Liao (1994), the utilitarian form of the ordinal logit model has indicated as follows:

$$y* = \sum_{k=1}^{k} \beta k + \varepsilon \tag{2}$$

y*= is in secret and along these lines can be the idea of as the hidden propensity of an observed phenomenon

ε is accepted where it follows a specific symmetric distribution with zero methods, for example, standard or logistic appropriation. What has noticed is

$$\begin{aligned} y &= 1 \quad \text{if } y^* \leq \mu_1 \\ y &= 2 \quad \text{if } \mu_1 < y^* \leq \mu_2 \\ y &= 3 \quad \text{if } \mu_2 < y^* \leq \mu_3 \\ y &= j \quad \text{if } \mu_{j-1} < y^* \end{aligned} \tag{3}$$

Where y is observed in j number of ordered categories, are unknown threshold parameters separating the adjacent categories to be estimated with The general form of the probability that the observed y falls into category j and and the are to be estimated with an ordinal logit model is:

$$\text{Prob}(y = j) = 1 - L\left(\mu_{1-1} - \sum_{k=1}^{k} \beta_k x_k\right) \tag{4}$$

Where L(.) speaks to the total logistic appropriation

Tilahun (2008) and Roman (2010) have identified three categories of the respondents: low, medium, and high dependent on their different score values. The current investigation depended on their order that is low, medium, and high. Relies upon considering the mean worth score assessment of the respondents got for the whole exercises. Consequently, the respondents' classification dependent on their participation score value was 4-8, 9-12 and 13-16 for low, medium, and high classifications independently.

RESULTS AND DISCUSSION

To decide the sample respondents' participation status, Participation Index has set up by utilizing four indicators of investment in Watershed management found from the literature survey. The ranchers' investment level has estimated by figuring the score estimations of every respondent based on the allotted indicators exercises.

The base score esteem was 4, and the prominent score esteem was 16 for each respondent. The results from the indicators in Table 3 revealed that 26 (28.9%) of the inspected respondents are under low-interest level, 53 (58.9%) are under medium support level, and 11(12.2%) of the respondents are under the high level of participation.

Table 2. Participation level and their score ranges.

Categories of Participation	Number	%	Participation Score
Low	26	28.9	4-8
Medium	53	58.9	9-12
High	11	12.2	13-16
Total	**90**	**100**	**4-16**

Ordered Logit model has used to recognize the elements influencing the farmers' in watershed management in the investigation region. Subsequently, factors theorized to affect the Farmers' participation in watershed management have tested in the model and out of 17 explanatory variables 8 of them have discovered to be significant. Among those factors tested into the model; educational level, dependency ratio, family size, land size, distance to the land from residence, soil fertility, extension contact and access to credit have discovered to be significant at 1%, 5% and 10% likelihood levels.

Table 3. Output of the Ordered Logit Regression Model.

Explanatory variables	Estimate	Std. Error	Wald	Sig.	Odds
AGE	0.37	0.40	0.896	0.344	1.038
EDULVL	0.644*	0.337	3.656	0.056	1.904
DEPNDCY	-4.045**	1.971	4.212	0.040	0.017
FMSIZE	0.322*	0.170	3.596	0.058	1.379
FARMSIZE	1.116***	0.342	10.631	0.001	3.053
TLU	0.016	0.124	0.016	0.899	1.016
SLOPE	-0.590	0.479	1.519	0.218	0.554
DISTANCEPCL	-5.291***	1.372	14.866	0.000	0.005
OFFFARM	0.852	0.666	1.639	0.200	2.344
FERTLTY	1.660*	0.884	3.523	0.061	5.259
EXTCONT	1.849***	0.555	11.107	0.001	6.353
SOURCELND	0.454	0.863	0.277	0.599	1.575
LANDSECUR	1.798	1.197	2.257	0.133	6.037
TRAINING	0.681	0.887	0.590	0.442	1.976
CRDTACCESS	-3.880***	1.139	11.606	0.001	0.021
PERCNSEP	1.288	1.704	0.572	0.449	3.625
NEWTECHAS	-0.854	1.044	0.668	0.414	0.426

Note: *, ** and *** = significant at 10%, 5% and 1% probability levels respectively.
Dependent variable: Farmers' Participation in Watershed Management
-2Log likelihood= 165.554
Chi-square = 86.613
Significant level: 0.000

The result of the Ordered logit regression on farmers' participation in watershed management has summed up in Table 3. From 17 theorized logical factors, eight of them are a significant effect on the farmers' participation in watershed management. These eight variables are educational level, dependency ratio, family size, land size, distance to the land from home, soil fertility, extension contact, and access to credit. However, the other nine explanatory variables, for example, the age of the respondents, number of livestock holding, the slope of the land, off-farm employment, source of land, land tenure security, training, perception of soil erosion as a problem and new technology acceptance do not have significant support on farmers' participation in watershed management.

Education influences farmers' decision to accept new technologies of watershed management by enhancing farmers' ability to obtain, understand and utilize the practice and improve the overall managerial ability of farmers. Therefore, more education to a farmer means more participation in watershed management practices. Education has estimated to have a positive effect on farmers' participation in watershed management. The model yield additionally underpins the theory. It shows that an expansion in long periods of education would bring about a 1.904 figure increment the ordered log-odds for being in a higher interest level. Simultaneously, various elements in the model has held consistent. The eventual outcome of this finding is dependable with the results of Long (2003).

Dependency Ratio indicates the number of people in a family who are not monetarily dynamic affects farmers' participation in watershed management negatively at 5% significant level. This is because in the families with a more massive consumer to worker ratio, an economically active member of the household shoulders the responsibility of feeding many people. To fulfill this responsibility, they engage in other activities which divert the resource (attention, labour, time…) away from their watershed management practice in general. Hence, they fail to give attention to watershed management practices. The model yield likewise underpins the theory and shows that the dependant family size has negatively influenced farmers' participation in watershed management practices. It shows that a unit increase in the number of dependents in given households would bring about a 0.017-factor decline in the ordered log-odds for being in a higher participation level. Interestingly, different elements in the model are held steady. The consequence of this finding is predictable with Bekele's (1998) results and Wagayehu and Lars (2003).

Family Size is the number of household members living together in terms of adult equivalent. It has estimated that it has a positive relationship with the dependent variable. This could be because managing watershed is labour-intensive if household labor is the only source of labor; households with larger household sizes participate in watershed management in general. The model yield also influences the hypothesis and shows that family size has positively affected the farmers' participation in watershed management at 10% likelihood level. It shows that when one unit of adult joins in the family would bring about a 1.379-factor increment in the ordered log-odds for being in a higher participation level, the other factors in the model are held constant. The aftereffect of this finding is predictable with the results of Woldeamlak (2003). However, it disagrees with the results of Bekele (1998). This states that family size is negatively related to farmer participation in watershed management.

Farm Size: Taking conservation measures in the watershed can be expensive and risky (Long, 2003) as the Physical Conservation measures impose a higher cost in terms of the land they put out of production (Wagayehu and Lars, 2003).

In various investigations led in Ethiopia, it has accounted for that conservation estimates take 10-20% of development land through embankments and earthen channels (Campbell, 1991) and land removed from cultivation increases quickly with expanding slope (Belay, 1992). This makes the advantage that will be acquired from saving the soil in little homesteads to be less disposed to compensate for diminishing yield on account of actual protection measures (Wagayehu and Lars, 2003). It was hypothesized that it has a positive effect on farmers' participation in watershed management. This is because the farmers' huge landholding size can hold up under danger of loss of productive land from conservation structures of the watershed. The model yield also underpins the theory, what's more, it shows that ranch size has influenced the support of the farmers' in watershed management emphatically huge at 1% likelihood level. It shows that a farmer holds more hectare of land would bring about a 3.053-factor increment in the ordered log-odds for being in a higher participation level, while the other factors in the model have held consistent. The outcome of this finding is reliable with the consequences of (Belay, 1992).

Distance of a Parcel of Land from Farmers' Residence:
The separation of a land package from farmers' habitation speaks to how far the bundle of land has arranged from home, as indicated by farmers' evaluations.

Farmers residing close to their cultivation land invest more on watershed management practices than their counterparts living at a distance. This is because land cultivation closer to the residences receives more attention and supervision than land situated at the farthest distance. Farmers also want to invest more in the field that requires the least effort. It was hypothesized that distance influences farmers' participation negatively. The model yield likewise bolsters the theory and shows that the land's distance affects the farmers' participation in watershed management negatively significant at 1% likelihood level. The negative association implied that the farmers' cultivating land at the farthest distance is less likely to take part in watershed management practices. It shows that the distance of a parcel of land becomes far from the farmers' residence would bring about a 0.005 figure decline the Ordered log-odds for being in a higher support level, while various model elements have held consistent. The result of this finding is unsurprising with the results of Kessler (2006).

The model output also supports the hypothesis and shows that distance has influenced farmers' participation in watershed management negatively and significantly at 1% probability level. The negative association implies that farmers cultivating land at the farthest distance are less likely to participate in watershed management practices. It shows that the length of a parcel of land becomes far from the farmers' residence would result in a 0.005-factor decrease in the ordered log-odds in favor of being in a higher participation category, while the other variables in the model are held constant. The result of this finding is consistent with the results Kessler (2006).

Soil Fertility: Farmers' perception about soil fertility status of the land they cultivate influenced farmers' participation in watershed management positively and significantly at 10% probability level. Even though it was hypothesized that soil fertility influences farmers' participation negatively, the model output results that soil fertility has a positive association with farmers' participation in watershed management practice. This shows that the farmers who cultivate black soil (intermediary to rich soil in the zone) participate more in watershed management practices. The model yield also bolsters the speculation and shows that soil fertility has affected the farmers' cooperation in watershed management. It shows that an additional increase in soil fertility would result in a 5.259-factor increment in the Ordered log-odds for being in a higher cooperation level. In contrast, different factors in the model have held consistent. The consequence of this finding is predictable with the results of Wagayehu and Lars (2003). However, it contrasts with the conclusions of Osgood (1992), Valk and Graff (1995). They found that farmers invest more on none fertile land.

Extension Contact: The recurrence of extension contact with Development Agents has positively influenced the farmers' participation in the watershed management at 1% likelihood level. The positive association indicates that the farmers having close contact with DAs appear to better partake in watershed management practices. This is because; farmers reduce the risk associated with watershed management practices by obtaining adequate information. The frequent extension contact with DAs makes accurate and timely information readily available to farmers. It has hypothesized that extension contact influences farmers' participation positively. The model yield also underpins the theory and shows that extension contact has influenced the farmers' participation in watershed management. It shows that an increase in extension contact would bring about a 6.353 factor increment in the Ordered log-odds for being in a higher cooperation level, while different model components have held constant. The research finding results are reliable with the results of Benin (2002), Wagayehu and Lars (2003).

Access to Credit: Access to Credit represents a means by which a farmer accessed credit to invest in watershed management practices. Access to finance, both saving and credit, helps give the aggregates needed to put resources viz., land, housing, health and education into the fundamental family (Bekele, 1998). It was estimated to impact the farmers' participation in watershed management. The model output shows that access to credit has negatively influenced farmers' participation in watershed management and significantly at 1% likelihood level. The negative association implies that farmers who have access to credit are participate in other off-farm employment activities other than watershed management practices. This likewise infers better access to off-farm activities diminishes farmers' motivations to contribute on watershed management practices. This is because association in off-farm activities swarms out assets (time, labor, interest) required for the watershed's management practices, Gould (1989). The model output shows that an increase in credit access would bring about a 0.021 calculate decline in the requested log-chances for being in a higher support level, while various model elements have held consistent. The aftereffect of this finding is steady, with the results of Bekele (1998).

CONCLUSION

Watershed degradation is a danger to Ethiopia's economic improvement as it influences the rural area of the nation essentially. It has brought about by deforestation and improper use and the administration of the essential resources, (soil and water). It prompts both indigenous horticulture creation and extended risks of cataclysmic flooding, sedimentation and avalanches. Henceforth, effective watershed management becomes very crucial. In the area, the watershed management scope was presented with the objective of monitoring, creating, restoring damaged watersheds and expanding food security through expanded food creation/accessibility. These measures can orchestrate into three reliant on the land use type in which they have introduced. These are preservation measures on farmlands, insurance measures on slants and protection measures on slopes, and protection measures on corrupted grounds (to reestablish crevasses). Even though a lot of effort has done to manage watersheds, success has not been comparable with the effort made. It was found that farmers responded to the action by destroying watershed management practices fully or partially in their different reasons. Accordingly, about 28.9%, 58.9%, and 12.2% of farmers interviewed to participate in low, medium, and high watershed management, respectively. It was also found that farmers' participation in problem identification and decision making, planning and monitoring and evaluation is very low compare to their participation in the implementation level.

Different factors to farmers' participation in watershed management were assessed using an ordered logit model. The model has good predictive power. The model outcome uncovered that among the 17 variables were estimated to influence the farmers' participation in watershed management; eight variables were measurably noteworthy with the speculated sign as determinants of farmers' participation in the watershed the executives.

Consequently, the family size is positive and significantly influence the farmers' participation; the more prominent family members have the likelihood to more significant work commitment to watershed management. Dependency ratio negatively and influence the farmers' participation substantially; more dependency ratio diminishes time, work, and enthusiasm to partake in watershed management practices. Eeducation is positive and fundamentally influence the farmers' participation. The distance of parcel of land from residence positive and altogether influence the farmers' participation. Soil fertility is positive and overall influence the farmers' participation. Extension contact is positive and entirely influence the farmers' participation. Moreover, farmer households who approach credit were found to have negative and fundamentally affect the farmers' participation in watershed management.

Recommendations

For effective watershed management, farmers must be interested in recognizable issue proof and dynamic, planning, implementation and monitoring and evaluation levels. Moreover, policymakers and the extension service should pay due attention to farmers' participation in every level of watershed management.

Education has decidedly and essentially identified with the participation of watershed management. Hence, the government or policymakers should give due attention to expand informal and formal education like primary and secondary schools, Farmers Training Center (FTC) and like.

Dependency ratio has found to affect farmers' cooperation in watershed management. Hence, the government and NGOs working on this area need to create a strategic approach for the utilization of family planning services.

Farm size was found to affect the farmers' cooperation in watershed management. The farmers who have an enormous farm sizes contribute their resources mainly time and labor on their land, and the farmers who have fewer farm size are investing their resources on their other employment practices. Therefore, the government and NGOs working in this area need to have created awareness to undertake watershed management.

Distance of a parcel of land from farmers' residence has affected the farmers' interest in watershed management practice. Hence, Government and NGOs organizations working in this area need to make proper awareness creation activities through training for the farmers who have a parcel of land far from their residence.

Soil fertility was found to affect the farmers' participation in watershed management positively. Therefore, the government and NGOs working on this area need to make training on the skills required to undertake watershed management practice for the farmers who have less fertile soil.

Extension contact was found to have a positive effect on the farmers' participation in watershed management. Hence, the agricultural extension should be strengthened with a view of educating farmers on watershed management.

Access to Credit has found to affect the farmers' cooperation in watershed negatively. Hence, due attention is needed from the government and/or other concerned parties in providing adequate extension service in terms of training, etc.

Ethiopia Technical Terms
Kebele means Village
Woreda means District

DECLARATION OF COMPETING INTEREST

The authors declare that they have no conflict of interest.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

The authors declared that the following contributions are correct.
Daniel Balta: Data collection, write up, SPSS analysis.
Marisennayya Senapathy: Research guidance, manuscript grammatical and technical corrections.
Marisennayya Pandikumar: Statistical analysis, Table and Figure correction, write up.
Chinnaza Gods Will: Statistical Analysis, citation correction.

ETHICS COMMITTEE DECISION

This article requires an ethical committee decision. Ethical committee decision has been given from Wolaita Sodo University, and added to the Materials and Methods section.

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