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IMPACT OF SUSTAINABLE LAND RESOURCE MANAGEMENT ON þÿ H O U S E H O L D S I N C O M E , T H E OF JANAMORA WOREDA, NORTH ETHIOPIA

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M.Sc. THESIS

BY

YAHYA KEBEDE YEHA

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

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THESIS APPROVAL SHEET

As member of Board examiners of the masters of sciences (MSc.) thesis open defense examination, we have read and evaluated this thesis prepared by Mr. Yahya Kebede Yeha entitled "Impact of Sustainable Land Resource Management on Household Income, The Case of Janamora Woreda, North Ethiopia.'' We hereby certify that; the thesis is accepted as fulfilling the requirement for the award of degree of Master Science (MSc.) in Agricultural Economics.

Board of Examiners

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2._____ _____ _____

Name of Internal Examiner Signature Date

3._____ _____ _____

Name of Chairman Signature Date

DECLARATION

This is to certify that thesis entitled Impact of Sustainable Land Resource Management on Household Income. The Case of Janamora Woreda, North Ethiopia, submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in Agricultural Economics to the Graduate Program of College of Agriculture and Environmental Sciences, Bahir Dar University by Mr. YAHYA KEBEDE YEHA. It is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of our knowledge and belief.

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Major Advisor	Signature	Date
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Co-Advisor	Signature	Date

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Abbreviations

ATT	Average Treatment effect on Treated
ATU	Average Treatment effect on Untreated
BSWC	Biological Soil and Water Conservation
CSA	Central Statistics Agency
ETB	Ethiopian Birr
ECB	European Central Bank
ESR	Endogenous Switching Regression
GIZ	Deutsche Gesellschaft fur International Zusammenarbeit
HH	Household
ILRI	International Livestock Research Institute
IV	Instrumental Variables
KFW	Kerberos For Windows
LDC	Least Developed Courtiers
JAO	Janamora Agriculture Office
MoFED	Ministry of Finance and Economic Development
MoALR	Ministry of Agriculture and Livestock Resource
NGO	Non-Government Organization
PSWC	Physical Soil and Water Conservation
PSNP	Productive Safety Net Program
SLM	Sustainable Land resource Management
SLMP	Sustainable Land resource Management Programs

SWC	Soil and Water Conservation
TH	Transitional Heterogeneity
STATA	Software package for Statistical Data Analysis
UNICEF	United Nations International Children`s Emergency Fund

Abstract

This study investigated the impact of sustainable land resource management on household's income in Janamora woreda. `Sustainable Land Management`, a new move as an approach that will enable farmers to sustainably intensify their agricultural productivity and production by making use of the available land resources efficiently without compromising the benefits of the future generation. 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. The study employed 'with' and 'without' approach by comparing farmers who practiced in sustainable land resource management in their own land and farmers who did not practice those activities. Both quantitative and qualitative data types were used for analysis. Stratified random sampling technique was used to select the respondents of participants and non-participants for the survey. Data for the study was collected from randomly selected 322 farm households of whom 161 participants and 161 non-participants using semi-structured questionnaire. Secondary data were collected from different sources. Binary logit and Endogenous switching regressions model were employed to identify the determinant of sustainable land resource management participation and its impact on farmers' income respectively. The logit model result indicates that age of the household, marital status of the household, household's education status, total live stalk unit of the household, land size, distance of resident from land, membership of watershed user association are significant factors affect farmers' decision to practice sustainable land resource management. To capture the impact of sustainable land resource management on households' income, in Endogenous switching regressions model, the indicator was household total annual income in 2018. The result showed that participation in the sustainable land resource management had resulted in positive and significant impact on households' income which is ATT 31264 ETB, ATU 41520 ETB at 5 and 1 % significance level with a transitional heterogeneity of -10256 ETB. This shows how significance role of sustainable land resource management are in improving the income condition of poor farmers in the study area. It is recommended to participate farmers not participated in SLM activities and the SLM activities should be comprehensively and inclusively practiced in all farmers in the study area.

KEY WORDS: Impact, SLM, Endogenous Switching Regression, Income

1. INTRODUCTION

1.1 Background of the Study

In developing countries like Ethiopia, agriculture-based poor economies with fast-growing populations, degradation of land resources pose a serious threat in meeting the growing demand for food production (Molla, 2016). Ethiopia has been in continuous struggle to achieve the objectives of increasing agricultural production, reducing poverty and ensuring sustainable use of the natural resources, especially since the early 1990s. Increasing population pressure on an already degrading land resource has rendered the struggle even tougher (ILRI 2010). Increase in agricultural productivity cannot be attained even the short term late alone in the sustainable manner if the land resource base continues to be degraded. Hence, ensuring sustainable land management is a matter of critical importance for agricultural growth in Ethiopia.

In developing countries; land is a primary means of production, to the country economy, and generate a livelihood for large proportion of the population. Accordingly, land issues in developing countries in general, and in Ethiopia in particular is becoming a central focus and a concern of many scholars and policy makers. The land question of 1960s in Ethiopia, were exploitation of peasants by a few land lords and the ruling aristocrats came to an end in 1975, which nationalized all land and provided usufruct right to the farming population (Sintayehu, 2016).

But to avoid the previous limitations the current government has introduced certain modification on the problems related to efficiency, tenure insecurity, reducing farm size focusing on the agricultural productivity through provision of some agricultural packages. However, despite all these efforts the problem faced by the rural community and agriculturalists still persists, and current land policy is becoming a debatable issue. Up to now the arguments are revolving around two main streams. While some tried to stick to the political and economic passion, support the present land holding system (public ownership) presuming that the existing land policy is a special precondition to maintain sustainable land management procedure and have rural social security. The second groups are criticizers of the existing land policy stating: the present land holding system and its impact on economic,

environment, social and political process remains negligible- instead it leads to unsustainable use of resources. (Sintayehu, 2016)

Even under this circumstance the soil and water conservation efforts in Ethiopia is significantly important mainly aimed at conserving the remaining soil and rehabilitating the degraded land resources. Experience has showed that soil and water conservation efforts can only be productive if its economic feasibility and social acceptability dimensions are considered as great determining factors as its ecological importance. For example land degradation in the form of soil erosion and nutrient depletion presents a threat to food security and sustainability of agricultural production in many developing countries like that of Ethiopia. This situation is calling for a new move toward `Sustainable Land Management`, as an approach that will enable farmers to sustainably intensify their agricultural productivity and production by making use of the available land resources efficiently without compromising the benefits of the future generation (Molla, 2016). This new approach is come to work through government and non-government organizations in Ethiopia.

In Ethiopia the SLMP starts since 1970 and now covered 235 weredas of the country by supporting different development partners like World Bank, GIZ, KFW, and government of Ireland with 52 different technologies and 27 approaches. The main components of the program are watershed management, land administration, improvement of framework conditions, improved agricultural advisory services and project management. The program achieved cumulative of 175,510 ha of communal and individual lands have been treated by undertaking various (more than 15 types) physical and biological measures till January 2013. This achievement is close to 83% of the total area targeted to be covered during the project life. (Tadesse, 2013)

The Amhara Regional State covers a total land area of approximately 154,000 km2 . The regional average landholding is 0.3 ha/household. According to the CSA, 2013 national population projection data from 2014-2017, the region has a total population of 20,018,988, out of which 84% live in rural areas. Even if more than 15 soil types are found in the region, leptosols, followed by Vertisols and Cambisols exist predominantly. Under SLMPP 48 weredas in the region are targeted for the implementation of SLMP activities. (MoALR, 2018)

In Amhara regional state, where the study areas are located, Sustainable Land Management Program (SLMP) works on integrated land resource management in different woreda. The study was therefore conducted aiming to assess the impacts of this management approach on households' income in the case of Janamora Wereda in north Gondar zone.

1.2 Statement of the Problem

Soil and water conservation technologies and practices were promoted through the Ministry of Agriculture mainly in the highly populated Ethiopian highlands including the study area, where scarcity of land resources becomes the critical challenges and bottlenecks of smallholder farmers, besides the traditional nature of their production systems. Moreover farmers have been cultivating their farmlands over several years through limited intensification with improved agricultural inputs, technologies and management practices. The situation requests the need to understand how the farmers' perceived the problem of soil erosion and their responses to soil conservation practices mainly in the study areas which have not yet been well studied. Moreover the factors influencing the use of soil conservation measures were not clearly identified (Shiferaw and Holden 1998).

Several studies showed that poverty had many dimensions and many determinants. Lack of agricultural productivity is one of the causes of food shortage and income poverty for rural society of the northern Ethiopia (Gebremedhin, 2003). Land degradation, lack of technology and lack of extension service and lack of financial institutions are some among a lot of causes of low agricultural productivity (Gebremedhin, 2003).

In the study *wereda* Janamora land resource management has been implemented mainly through the coordination of *wereda* rural development and agriculture Office. Since Janamora is one of the poor weredas in the Amhara region population is supported by Productive Safety Net Program (PSNP) and other non-government organization such as SLMP, Action Aid and UNICEF. The main SLM activities done in the study area focused on soil and water conservation and management, those are soil bund, stone faced soil bund with biological treatments and without biological treatments, fallowing, using natural fertilizers, tie-ridging and others which are discussed in chapter four.

Based on those facts and others; sustainable land resource management is one of the remedies to alleviate the rural income or economic poverty. In addition to the government's effort to

sustainable land resource management programs NGOs work by taking some kebeles of the wereda by holistic approach of SLMP. Despite the programs run in the wereda, the impacts of the program on house hold income is not well studied in the area. So that this paper identified and examine the extent of the impact of sustainable land resource management program on target rural households income by taking the main interventions focuses of the program which are soil and water conservation 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 (Yitayal and Adam 2014). Therefore this study tried to answer whether soil and water conservation had impact on rural household income or not, and also it would answer about the status of sustainable land resource management and its determinants.

1.3 Research Objectives

The general objective of this study is analyzing the impacts of sustainable land resource management on household incomes of Janamora Woreda; and it specifically aims:

- To see the level of adoption of sustainable land management practices in the wereda;
- To examine the determinants of participation in SLM activities of farmers in their land; and
- To identify the impacts of soil and water conservation activities/practices on rural house-hold income in Janamora wereda.

1.4 Significance of the Study

Different agricultural programs aimed to have a positive reward of better life of the agrarian society. Studying impacts of different interventions of programs had a great significance to the betterment of the programs towards the main and grand goals of the program which is essential policy makers and program holders to take lesson. By this study; the *wereda* administration, agriculture office, and regional administration would have a better input to learn and to do better for tomorrow. The other significance of this study is it will be used as either a secondary, or and beginning issue for other and further study on issue in hand.

1.5 Scope and Limitation of the Study

The scope of this study is geographically for Janamora *wereda* of North Gondar administrative zone. The study topic is very vast but two main elements of sustainable land

resource management which more linked to rural house hold income are selected which are soil and water conservation in households' private land, and income generating activities focused on modern soil and water conservation technologies mainly soil bund, stone faced soil bund with biological treatments and without biological treatments as well as other soil and water management activities. The limitation of this study would be lack of diversity of soil and water conservation technologies to be studied. Since conservation technologies and strategies are vast based on agro-ecology difference, soil type, and other technical, social and economic situations, this research had cover some very important and adapted soil and water conservation technologies and their cumulative impacts on rural household income.

2. LITERATURE REVIEW

This section discusses the definitions of key terms that have been used in this paper related to the sustainable land resource management, the conceptual frame work and empirical evidences from review of similar studies.

2.1 Definitions and Concepts of terms related to SLM

The concept of Sustainable Land Resource Management can be defined as the use of land resources such as soils, water, animals and plants for the production of goods to meet changing human needs while assuring the long-term productive potential of these resources and the maintenance of their environmental functions (Burnham et al., 2003 as cited in Molla, 2016). Sustainable land management is the foundation of sustainable agriculture and a strategic component of sustainable development and poverty alleviation.

knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods.

SLM is necessary to meet the requirements of a growing population. Improper land management can lead to land degradation and a significant reduction in the productive and service (biodiversity niches, hydrology, carbon sequestration) functions of watersheds and landscapes. (Burnham etal, 2003 as cited in Molla, 2016).

In layman's terms, SLM involves; preserving and enhancing the productive capabilities of land in cropped and grazed areas that is, upland areas, down slope areas, and flat and bottom lands; sustaining productive forest areas and potentially commercial and noncommercial forest reserves; and maintaining the integrity of watersheds for water supply and hydropower generation needs and water conservation zones and the capability of aquifers to serve farm and other productive activities. Actions to stop and reverse degradation or at least to mitigate the adverse effects of earlier misuse which is increasingly important in the uplands and watersheds, especially those where pressure from the resident populations is severe and where the destructive consequences of upland degradation are being felt in far more densely populated areas "downstream."

It is a general fact that agricultural productivity and production must be increased and intensified on land, which is already brought under cultivation. Apart from this, the major

portion of most developing countries population are still involved in the un-mechanized and primitive forms agriculture, livestock production, forestry and fishery, and their livelihood and options for economic development are directly linked to the quality of the land and its resources

Sustainable land management pursues to complement the often-conflicting objectives of intensified economic and social development while sustaining and intensifying the ecological roles of the land resources. Basically, practicing the principles of sustainable land management is amongst the few possibilities which will enable income generation without jeopardizing the sustainability of land resources as a basis of production.

Mitiku *et al. as cited in (Molla 2016)* pointed out that sustainable land management can be approached by looking at the symptoms of un-sustainability, which can include soil erosion and degradation, decline in water quality, degradation of biodiversity, occurrence of plant insect and diseases, etc., which are the end results of inappropriate land management practices. Soil and water conservation as a means for a sustained management of land has been reflected as technical issue based on years of dominantly biophysical problem oriented research on factors such as climate, soils, topography, land use and vegetation. However, much is not done to provide solution oriented evidence whereby drawbacks on the compatibility of technical solutions with prevailing social, cultural and economic settings for specific areas about the processes of adopting soil and water conservation as a means for the sustained management of land resources.

In addition to the above concepts and definition of the term SLM there are also some definitions stated by different scholars and organizations since its term is popular at the end of 20^{th} century. As illustration Smith and Dumanski (1993) defines SLM objectively as harmonize the complimentary goals of providing environmental, economic, and social opportunities for the benefit of present and future generations, while maintaining and enhancing the quality of the land (soil, water, and air) resource furthermore, world bank defines SLM as the process by which the resource of land are put to good effect. It covers all activities concerned with the management of land as a resource both from an environmental and from an economic perspective. It can include farming, mineral extraction, property and estate management, and the physical planning of towns and the countryside. (WorldBank1996).

So the above mentioned concepts are not exhaustive regards to SLM, but for this study which focuses on impacts of SLM on households income is taking its definitions which are related to agricultural income variables. Since the rural household in the study area main income sources are agricultural products which are emanated from agricultural productivities. Productivity enhancement and keeping sustainable is being keeping the farm land quality that is soil fertility and moisture conservation. Indeed the concept of SLM is not only about the land quality improvement practices rather its use and management influenced by land use policy and other socioeconomic variables discussed in chapter four.

2.2 Income Distribution and Its Determinants: Some Conceptual Considerations

Income: it is a person's earnings depend on the supply and demand for that person's labor, which in turn depends on natural ability, human capital, compensating differentials, discrimination, and so on. According to Afonso, et al., (2008); at a given point in time, and in a given country, without the current intervention of the government, through taxation, spending policies, and regulations, the income distribution that would emerge would be largely determined by different factors: such as; the inheritance of tangible and financial wealth; the inheritance of human capital, including within-the-family learning as well as the inheritance of attitudes toward learning, work, risk and so on. Whether inherited, genetic factors can play a role in this process is still a highly controversial area; the inheritance of useful connection, positional rents, and other valuable assets that determine a person's social capital; societal arrangements and norms, such as whether individuals tend to marry individuals with similar wealth or educational background; real or de facto caste systems, and so on; individual talent; and past government policies.

In addition to the initial conditions mentioned above, that are largely determined by inheritance and societal traditions and norms, there are more individually-nested, or random factors, which also play important roles. These are the distribution of skills, intelligence, and even look not directly inherited; and what could be called luck, or the role that randomness plays in determining incomes in non-traditional and market oriented economies.

In a market economy, individuals with exceptional skills in various areas (entertainment, sport, economic or financial activities, and so on) are more likely to end up with exceptional incomes. In many cases luck (or a randomness factor) will also play a role? Some of these

individuals may end up in the annual Forbes or similar lists of the world richest individuals and will have an impact on Gini coefficients or on other measures of inequality.

Initial conditions, exceptional skills, luck, and past public policies will combine with the working of the market to determine the distribution of income that prevails in a society before the current intervention of the government. Afterwards, to determine the distribution of spending power among the population the government steps in with taxes, public expenditures, tax expenditures, and some relevant regulatory policies. Relevant regulations will be (a) those that control prices or rents; (b) that determine hiring quotas for some categories of individuals; (c) that establish property rights for patents or for other forms of intellectual property; (d) that pursue anti-trust policies and so on (ECB, 2008).

According to ECB., 2008 it shall not be able to take into account regulations in our empirical work and will also ignore the impact that progressive tax systems can have on the after tax distribution of income. Much of the focus of the bank was on public spending and policy outcome and their impact on inequality. It may be worthwhile to stress that the impact of the government on the income distribution may be direct or indirect and that this distinction is in part linked with the current and past impact of the government.

The direct and current impact of the government can come through taxes and through spending and other public policies. The level of taxation and its progressivity is the most direct factor. This factor, per se, can make the distribution of after-tax incomes different, and presumably more equal than the pre-tax distribution. However, various forms of "tax expenditures" that indirectly subsidize some categories of private spending – education, health, training, expenses connected with mobility, etc. will undoubtedly, over time, have some impact on income distribution. Through its features, the tax system can also influence the retirement age, the size of families, and individual effort, which are all features with a direct impact on income distribution.

On the expenditure side of public policies we can also identify direct and indirect effects. Public spending that injects income or spending power in the hands of individuals, through cash payment or direct support for spending that is important for poorer individuals (food stamps, subsidized housing, free child care for working mothers, subsidized tariffs for low levels of consumption of public utilities, etc.) has a clear effect on income distribution. However, public spending can have indirect but still significant effects on the distribution of

income in other ways that mainly improve productivity and opportunities to find a job disproportionately for the less well off. For example an efficient public transportation system can widen the area in which poorer individuals can search for jobs by reducing travel costs. Spending for job training or retraining can move individuals from the unemployed to the employed category. Spending on education can benefit the poor disproportionately if it improves their relative endowment with human capital. Free access to health facilities can keep people healthy and make possible for them to be in the labor force.

In addition to the above, it has to be recognized that a good institutional set up that guarantees rule of law and fair and quick access to justice will also contribute to a better distribution of income by reducing abuses and corruption. Some studies have, for example, linked corruption with higher Gini coefficients. When rule of law is not fair or is not respected, poorer people are more likely to be exploited through lower compensation for their work and higher costs for some services, as for example in the case of usury when they borrow money.

The above description suggests clearly that while some public actions or policies have an immediate and direct impact on the distribution of income or on the income of some groups, others have an indirect impact or an impact only over time.

Since income is defined in this subsection, the income of the household at the time of the study in the study area was incorporated through valuating all earnings from different source by the timely prices.

2.3 Empirical Evidences

In Ethiopia, specifically in northern Ethiopia agricultural productivity, household income, and land degradation are affected by many factors. Due to this, only less than 10 per cent of this potential land has been cultivated which is estimated at about 7 million hectares in any one crop season. Around 95 per cent of the cultivated land is under smallholder farming and the rest under state/commercial farms. The country has not been self-sufficient in food and chronically dependent on food aid of various reasons responsible for food deficit, low/poor land productivity is the most crucial. The average yield for grain crops has remained around 11 quintals per hectare. This lower land productivity is not because of the poor soil fertility rather as a result of ill management of the limiting factor of production, i.e. land and also due to rapid increasing of population (Gebreselassie, 2006; cited in Sintayehu 2016). Effect of rapid increasing of population on land productivity and livelihood of the citizens is illustrated

by Holden and Shiferaw (2000: 4) and their statement goes like this: “in a country with a fast growing population vulnerable to frequent famines, loss of food production potential is a concern not only for future generations but also for the present generation of Ethiopians. This has attracted several scholars and motivate them to come up with different opinion, all tried to contribute to introducing or adoption of sustainable land management procedures.

The first groups in the literature of sustainable land management have tried to blame to the land policy as a factor but the second groups pin point on the method of cultivation, type of crops produced, and knowledge of the household about land use and resource allocation as main obstacles for the land management to be more of unsustainable type. To the first groups land privatization is considered as a better approach so as to have more tenure security, a system that provides the necessary incentives for farmers to manage their land more efficiently and invest in land improvement. Absences of land privatization constitute a serious constraint on economic and social development. On the one hand, insecure land tenure and dysfunctional land institutions discourage private investment and overall economic growth. Besides skewed land ownership distribution and discrimination according to gender or ethnicity limit economic opportunities for disadvantaged groups and provide fertile conditions for social conflict which often erupt in violence. The proponent of this view Hoben (2000, p.7) reveals the disadvantage of having state ownership claimed that “the current system does not guarantee tenure security and undermines incentives, has detrimental effects on agricultural productivity and natural resource conservation. Current land policy does not give farmers secure rights over the land they use, does not maintain equitable access to land over time, does not provide incentives for investment in improvements or conservation, and does not encourage farmers' entrepreneurial and experimental efforts to better their lot. From a policy perspective, it does not foster agricultural intensification, improved environmental management, accretion capital formation, or rural development.", accordingly, recommends the necessity of changing the existing land holding system not only to improve the wellbeing of the rural community but also to protect the environment. Others (such as government officials and academicians) who support government ideology claim that if the current policy were changed in favor of private ownership it would encourage rural farmers to sell their land. Their argument indicates how the current policy is protecting the farmers from a possible loss

of their prized and perhaps irretrievable asset which would occur if and when polices like full land ownership rights were conferred.

Other streams of argument tried to highlight the advantage and disadvantage of implementing both; private versus social ownership. Study conducted by Holden and Shiferaw (2000), shows the divergence between private and state ownership: "the divergence between private and social paths of land use in LDCs may be attributed to imperfect information, high transaction costs, imperfect insurance and capital markets, incomplete property rights, and misguided government policies."

Generally, scholars from each group are giving different justification as a source of tenure security, maintaining land sustainability, improving livelihood of rural community, and reducing of poverty. However, despite the increasing concern about the present land holding system there is no nationally applicable idea (blue print) as to what an appropriate land versus environment policy should be. Since this study is not a detail investigation of land tenure system and its implication on land sustainability one could not draw a conclusion in support/against the existing land tenure system of Ethiopia. However it can be argued land use, administration, management, and other related factors influences land sustainability and productivity directly or indirectly. Moreover, absence of specific policies that address environmental related issues could be another important factor for the continuous degradation of resources in the Ethiopian highlands.

Problems related to environment are treated as homogenous to agricultural related problems and there is no specific designed blue print; and policy instruments that efficiently internalize land degradation externalities. Land degradation, especially soil erosion and nutrient depletion are major problems in the high lands of Tigray (Sintayehu, 2016); He argues that; the proximate causes of land degradation are complex array of factors that affects sustainable land management and diverse agro-ecological and economic conditions of the region. These includes cultivation of steep slopes and erodible soils, low vegetation cover of the soil, burning of dung and crop residues, declining fallow periods, law and uncertain rainfall, and limited application of organic and/or inorganic fertilizer, fuel and animal feed, limited farmer knowledge of integrated soil and water management measures., lack of access to credit, and other factors. This suggests that in addressing these issues, there is a need to rethink about how to implement appropriate sustainable land management approaches and policies.

Government policies and programs can play a crucial role in this regard through creating a level playing ground by drafting of policies, which are coercion type and encouraging of communities to participate in environmental protection activities willingly. These include macroeconomic and sectorial policies, land tenure policies, agricultural research and extension policies credit programs, infrastructural development programs. There should be specific policies that could address environmental related problems (Gebremedhin 2003).

Some previous studies conducted in this line tried to emphasize on the environmental policy, argued not mainstreaming the land management problems, and absence of complementary policy related to land management leads to worsen the manner of land utilization. A typical argument that could characterize this claims that- "Appropriate institutions and policy instruments that efficiently internalize land degradation externalities are urgently needed in many countries suffering from deterioration of their resource base." (Holden and Shiferaw 2000).

Moreover, there are several debates about current policy, farmer's mobility and environmental degradation. Since land policy in Ethiopia demands permanent residence in a farming community to be eligible for use right over a piece of land, the confinement view accuses the policy of having shackled farmers and forced them to be permanently stayed in rural areas. This has hindered farmers from looking to other alternatives income generating activities, limited them to subsistence agricultural producers with limited income and slow transformation.

Even the government has already realized the problem of overcrowding of population in small land, land scarcity and land fragmentation and its effect on the livelihood of the community, and on the overall economic development of the state. It is due to this fact various development packages has been introduced and farmers are encouraged to adopt a development package, which is convenient to them. The package includes both, on farm and non-farm income generating activities and is expected to enhance farmers' participation in various development programs, including on environment protection, synergy effect.

Experience reveals though large number of farmers are not risk takers, some (risk takers) who involved in the package (both, on and off farm type) program are able to attain significant change in their livelihood. For instance leasing out forests for specific periodk2 (on short

lease base, 1-3 years) so as to rehabilitate the already degraded resource could serve as a best overcoming mechanism to the problem of deforestation and land degradation.

Outcome (result of adopting) reveals mixed effect: The first categories are these who managed to improve their income (increasing), and their resource use (protecting soil degradation and forestation). The second categories are these who adopt package and as a result manage to change their livelihood but increasing their income did not have any implication on their resource use. The third categories are these who adopt package but did not mange either to increase their income or improve their resource use.

The first groups are risk taker farmers who adopt mixed package (crop production using irrigation, input (fertilizer), and livestock reproduction). Consequently, their total income earned and their livelihood got improved, transform themselves from low income to middle income. At the same time increasing in income has encouraged them to increase their investment on land. This reveals how Increasing number of livestock's and/or increasing of their income are playing multiple roles -to raise income of the household and at the same time to rehabilitate the environment.

Moreover, these who preferred package of agro-forestry and horticulture are equally benefited, motivated to diversify their source of income, become market oriented producers, and efficient resource users. Unlike the past farmers who engaged in the production of fruits (agro-forestry); have already realized the economic losses that occur from erosion. This has encouraged them to improve the land quality though making continuous investment in conservation.

However, it does not mean that all packages are effective enough to improve land sustainability, these who adopt petty trading package. Since the income they got form off farm is higher than from farm they start to regard agriculture as secondary source of income (women and young people, preferred to rent out their land). This is consistent with the findings of (Holden et. al., 2000). "Improved access to non-farm income undermines incentive to conserve land; the overall effect is increased degradation in the form of erosion."

The third groups are these who adopt package but don't able to use the resource efficiently.

To these groups package programs didn't contribute either to the improvement of their income or to the change (improvement of) of land conservation, they remain defaulters.

Finally, as per different studies on related topic empirical and conceptual facts income of rural house hold had dependent on the development of production lands and the relationship of two variables would be affected by social, economic and institutional or policy factors which are incorporated in chapter three of this study.

2.4 Conceptual and Theoretical Framework

Since income had many dimensions and aspects, and the concept of sustainability and land resource management is a vast subject, studying on the issue requires workable and valid conceptual frameworks related to factors affecting income strategies, land management, and their implications indicated in Figure 1.

For the purpose of this study John Pender's` conceptual framework is more appropriate and has been used. As Pender discussed in his study `` effects of key factors on community and household decisions concerning income strategies and land management1``; Income strategies would have been affected by Many factors such as agricultural productivity, household income, and land degradation. The central focus of this study is on the determinants and results of people's decisions on land management practices to households' income or income strategies.

Pender define income strategies as the set of activities that households pursue to produce or acquire income and consumption goods, such as subsistence production of food crops, production of perishable cash crops, livestock production, forestry, and nonfarm activities. The main hypothesis is that such strategies have important direct implications for the outcomes of interest, and also affect them indirectly by influencing technology adoption and land management decisions. For example, production of high-value horticultural crops or other cash crops may lead to higher household incomes than production of food crops simply because the profitability of such crops may be greater than that from food crops. But they may also promote greater productivity, land improvement, and increased income indirectly by promoting greater use of purchased inputs, labor, or adoption of labor or capital intensive land improvements because higher value production increases the value of these inputs and the ability to finance them

Land Management Agricultural production and land conditions are affected by land management practices, including both private decisions made by farm households and collective decisions made by groups of farmers and communities. For example, farm households make decisions about land use (whether, for example, cropland or grazing land), the crop types to plant, the amount of labor to use, and the types and amounts of inputs, investments, and agronomic practices to use to conserve soil and water, improve soil fertility, reduce pest losses, and so on. Communities also can influence.

Determinants of Income Strategies and Land Management Income strategies and land management decisions are affected by many different factors operating at different scales. These include factors that influence the relative profitability and hence comparative advantage of different income strategies and land management practices in a particular location, such as biophysical factors determining agricultural potential, population density, and access to markets and infrastructure (Pender 1999). These factors largely determine the comparative advantage of a location by affecting the costs and risks of producing different commodities, the costs and constraints to marketing, local commodity and factor prices, and the opportunities and returns to alternative activities, such as farming versus nonfarm employment.

These factors may have generalized effects at the village or higher level on income strategies and land management, such as through their influence on local prices of commodities or inputs, or they may affect household-level factors such as average farm size. Another important factor influencing income strategies and land management is access to programs and services, such as government or nongovernmental organization (NGO) technical assistance and micro–finance institutions, education and health services, and so on. Some of these programs and services, such as access to technical assistance and education, can affect local comparative advantages by increasing access to technologies and information, thus expanding households' available production and marketing possibilities. These and other programs and services also influence household constraints that affect income strategies and land management, such as limited access to finance and production inputs or labor constraints related to the health status of individuals. Local institutions also have important influences on income strategies and land management.

Household-level factors such as households' endowments of physical assets (e.g., livestock and equipment), "human capital" (assets embodied in people's knowledge and abilities, such as education, experience, and training), "social capital" (assets embodied in social relationships, such as through participation in organizations or informal networks), "financial capital" (access to liquid assets, including credit and savings), and natural capital (assets embodied in natural resources, including the quantity and quality of land, access to other resources) may also determine the income strategy and land management practices pursued by particular households. For example, education and access to financial and social capital may be critical in determining households' ability to take advantage of remunerative nonfarm opportunities.

Agricultural potential is an abstraction of many factors, including rainfall, altitude, soil type and depth, topography, access to irrigation, presence of pests and diseases, and others, that influence the absolute (as opposed to comparative) advantage of producing agricultural commodities in a particular place. There are, of course, variations in potential depending on which commodities are being considered. Furthermore, agricultural potential is not a static concept but changes over time in response to changing natural conditions (such as climate change) as well as human induced conditions (such as land degradation).

In areas of generally higher agricultural potential, such as in highland areas having favorable rainfall and fertile volcanic soils, we would expect the highest value commodities, such as horticultural crops, tea, and coffee, to be produced. Lower-value commodities such as cereals are more likely to be grown in areas of lower potential, along with complementary livestock production (McIntire, Bourzat, and Pingali 1992).

In general, higher agricultural potential is expected to be associated with higher labor intensity and adoption of more labor and input-intensive practices, by increasing the marginal return and/or reducing the risks of these inputs (Barrettet al. 2002). By contrast, adoption of some soil and water conservation measures may be more profitable and less risky in low-rainfall areas because they may have a larger impact on yields in the short run by conserving scarce soil moisture and may be less prone to harboring pests and weeds than in high-rainfall environments (Herweg 1993).

Access to markets and infrastructure is critical for determining the comparative advantage of a given location, given its agricultural potential. For example, a community with an absolute advantage in producing perishable vegetables and dairy production and other intensive livestock operations. The positive effect of market and road access on input use may have further influences on use of labor-intensive practices.

Irrigation may promote investments in complementary soil and water conservation investments and practices, such as investments in soil bunds and drainage (Pender and Kerr 1998). It may also encourage farmers to adopt complementary productive inputs such as fertilizer; particularly where soil moisture constraints limit farmers' willingness to use fertilizer, As a result of these effects, irrigation is likely to contribute to increased value of crop production and incomes.

Land degradation may increase as a result of cultivation on fragile lands, reduced use of fallow, increased tillage, mining of soil nutrients, and other potential results of agricultural expansion and intensification. On the other hand, more labor-intensive investments in land improvements and soil fertility management practices as a consequence of lower wages relative to land values resulting from population pressure may improve land conditions.

The other point is access to credit which affects both participation decision of farmers as well as their income. The net effects of credit on land management, crop production, and land degradation are thus ambiguous. The impact of credit availability on income is likely to be positive, provided households have profitable uses for it (otherwise the effect may be nil or even negative). When credit is constrained, households with greater access to off-farm income may be more prone to use inputs or make investments that require cash, such as fertilizer or hired labor (Reardon et al. 2001). On the other hand, households with greater off-farm opportunities may be less prone than others to invest labor in crop production or labor-intensive land management practices because their opportunity costs of labor may be higher.

Livestock producers may obtain better crop production because of deposition of animal manure on their fields (even if they are not investing effort in collecting and applying manure). Households involved in nonfarm activities may have advantages in liquidity and risk

management that enable them to obtain better prices for their crops (e.g., by not being forced to sell right at harvest).

Income strategies may also have impacts on land degradation. For example, households producing higher value crops or having nonfarm income may be more likely to replenish soil fertility by using fertilizer, or may invest more (or less) in soil and water conservation measures, as argued above. The impacts on land degradation will depend on the net effects of decisions affecting crop choice, input use, and land management practices. Income strategies are also expected to affect household incomes and poverty. Households able to rely on high-value crops, intensive livestock systems, or remunerative nonfarm activities are likely to earn higher incomes than those confined to subsistence food crop production (Tiffen, Mortimore, and Gichuki 1994; Barrett, Reardon, and Webb 2001). On the other hand, households dependent on low-wage off-farm employment may be poorer than even subsistence farm households.

Access to Programs and Services access to programs and services can influence the income strategies and land management practices of communities and households by affecting their access to information about technologies, their capacities to effectively use technologies or to organize collective action, and their financial or other constraints.

Technical assistance of programs and organizations very crucial point; because natural resource management (NRM) technologies are knowledge-intensive (Barrett et al. 2002), technical assistance is likely to be an important determinant of their adoption. Presence of programs and organizations is likely to improve delivery of NRM technologies. However, the effects of participation in programs and organizations will likely depend on their focus.

Education is likely to increase households' opportunities for salary employment off farm and may increase their ability to start up various nonfarm activities (Barrett, Reardon, and Webb 2001; Deininger and Okidi 2001). Education may increase households' access to credit as well as their cash income, thus helping to finance purchases of physical capital and purchased inputs. This may help to promote production of high-value crops and intensive livestock production as well as promoting greater use of such capital and inputs in producing traditional food crops. Education may also promote changes in income strategies and technologies by

increasing households' access to information about alternative market opportunities and technologies, and hence households' ability to adapt to new opportunities (Feder, Just, and Zilberman 1985, cited in Pender 1999). On the other hand, more educated households may be less likely to invest in inputs or labor-intensive land investments and management practices because the opportunity costs of their labor and capital may be increased by education. Thus, the net impacts of education on land management, crop production, and land degradation are ambiguous. The impact on household income is expected to be positive.

Property Rights and Land Tenure Property rights and the form of land tenure can affect land management and productivity for several reasons. If there is insecurity of tenure, the household operating the plot may have less incentive to invest in land improvement. This is not necessarily the case, however, if the household can increase tenure security by investing in the land (Otsuka and Place 2001). In that case, there may be more investment on land having insecure tenure.

To summarize the above mentioned concepts government policies, programs and institutions are vital instruments for agricultural production potential, selection of income strategies, land management (either private or collective) which affects cumulatively the outcomes those are agricultural production, household income, land degradation or improvement and this conceptual; framework is illustrated in figure 1 below.

Theoretical frame work on impact analysis takes different approaches in different studies; IV methods PSM and Endogenous switching regression models are the most common models. The instrumental variable approach for controlling unobserved sources of variability is the mirror opposite of the propensity score method for controlling observed variables (Angriest et al. 1996). Unlike an observed control variable, an instrumental variable is assumed not to have any direct effect on the outcome. Instead, the instrumental variable is thought to influence only the selection into the treatment condition. In other words, the effect of the instrumental variable on the dependent measure is entirely mediated via its effect on treatment assignment.

The *propensity score* is the conditional probability of receiving the treatment rather than the control given the observed covariates (Rosenbaum and Rubin 1983). Note carefully that the

propensity score is defined in terms of the observed covariates even if there may be hidden biases due to unobserved covariates and ESR designs account for both endogeneity and sample selection bias by estimating a simultaneous equations model using full information maximum likelihood method (Lokshin & Sajaia, 2004); discussed in chapter three.

Figure 1 conceptual frameworks of the study

Adapted from John Pender (1999)

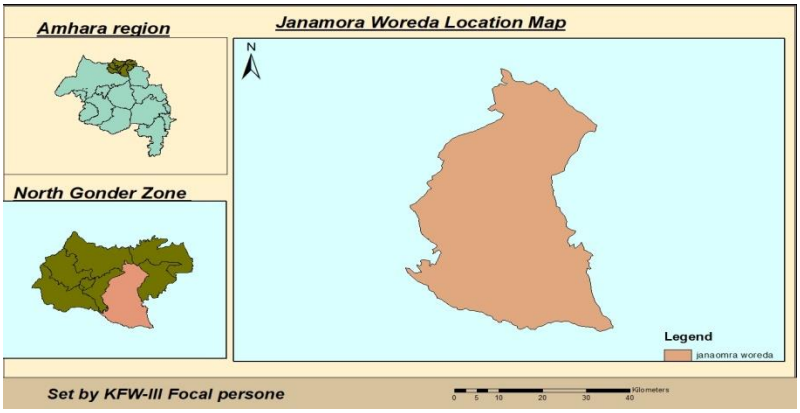
3. RESEARCH METHODOLOGY

In this chapter description of the study area is highlighted, research design which incorporates source of data, method of data collection, sample size determination and method of data analysis are discussed.

3.1 Description of the Study Area

The study area Janamora *Wereda* has been described with its geographical and demographical features below in figure 2 and table 1.

Figure 2 Location map of the study area



Janamora *wereda* is one of 6 *wereda* of the newly formed North Gondar administrative zone found in Amhara region of Ethiopia. It is located at 12°59′N and 38°07′E. Janamora is bordered with Beyeda and Adirkay in the North, Sahla in the east, *Belesa* in the south, *kinfaz-Begela Wogera* and *Debark weredas* in the west see Figure 2.

Table 1 Summary of Agro-ecology Zone of the study area

Agro ecology zone	*Rain fall range (millimeter)*	*Temperature range (^{o}c)*	*Altitude range (masl)*	*Area coverage (Ha)*
Alpine (Wurch)	1500-1800	-2-10	3200-4540	44117.42
Dega	1300-1500	10-15	2300-3200	66517.28
Woina Dega	1000-1300	15-20	1500-2300	70318.82
Kola	900-1000	20-25	1170-1500	13997.48
Total	-	-	-	194951

Source: *Janamora wereda* agriculture office (2018).

Janamora is rich in agro-ecological diversity (table 1). The minimum annual rain fall is 900 millimeter; the maximum annual rain fall is 1800 millimeter and the average annual rain fall is 1350 millimeter (JAO; unpublished).

Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), this woreda has a total population of 167,757, an increase of 33.65% over the 1994 census, of whom 84,456 are men and 83,301 women; 5,057 or 3.01% are urban inhabitants. With an area of 1,737.24 square kilometers, Jan-Amora has a population density of 96.57, which is greater than the Zone average of 63.76 persons per square kilometer. A total of 36,361 households were counted in this Wereda, resulting in an average of 4.61 persons to a household, and 35,389 housing units. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 94.8% reporting that as their religion, while 5.2% of the population said they were Muslim.

The 1994 national census reported total population for this Wereda of 125,516 in 26,918 households, of whom 63,335 were men and 62,181 women; 1,584 or 1.26% of its population were urban dwellers at the time. The largest ethnic group reported in Jan Amora was the Amhara (99.8%), and Amharic was spoken as a first language by 99.76%. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, k2with 93.81% reporting that as their religion, while 6.1% of the population said they were Muslim. But now a time in 2019 the population of the *wereda* estimated over 200000 people. (JAO unpublished)

3.2 Research Design

3.2.1 Source of Data

The study used both primary and secondary data sources. Primary sources of the data were farmers live in the *wereda* and the secondary data sources include periodic unpublished but authorized reports of the *wereda* and different relevant literatures written on this topic. So, different figurative and enumerative information had been incorporated in the study from secondary sources of data.

3.2.2 Sampling Techniques and Sample Size Determination

Janamora wereda agriculture office selected five kebeles to implement sustainable land resource management activities with the help of NGO which is SLMP (Sustainable Land

resource Management Program). The primary data were gathered from beneficiaries/participants and non-beneficiaries/non-participants of SLMP from those five kebele is directly affected by the program and practiced sustainable land resource management activities on their own farm fields. These five are among 38 rural kebeles in *Janamora wereda* that participated in sustainable land resource management since 2013. And there are 15 watersheds that demonstrated the SLM program within those five kebeles were also being taken as the primary source of this study. The other primary sources are the non-participant households from those program sites or kebeles as comparison groups.

Table 2 Sampling Frame of the Study

Kebeles	*Number of HHs*			
	Male	Female	Total	%
Denkolako	234	43	277	16.49
Deresge	368	107	475	28.2
Asenga	186	43	229	13.63
Serebar	174	38	212	12.62
Gashajagre	405	81	486	28.9
Total	1367	312	1679	100

Source: Janamora agriculture office (2018)

The study selected those five Kebeles (*Denkolako, Deresge, Asenga, Serebar and Gashajagre*) among the total 38 Kebeles available in *Janamora wereda*, as sustainable land management practices have been implemented in those sited for more than five years. Once these Kebeles were purposively chosen as a target population of this study, the final sampling units (households) were drawn after stratifying the population into two strata based on participation status of households in SLMP: participant and non-participant groups. Finally, samples of 322 households were drawn from the two groups, through use of simple random sampling technique. This selected respondent household represents the total population of 1679 households in those five SLMP-oriented Kebeles.

The SLM project had been worked for more than five years in the study area focused its intervention on both biological and physical soil and water conservation activities on five

kebeles of the *wereda*. The project works by selecting watersheds including farmers' individual land and communal land not only intervened by practicing the SLM activities rather works on capacity building on SLM works to the farmers and development agents and so far works on promoting farmers to participate in income generating activities and land use planning and implementation; and the indicators of the sustainability of participating and practicing the SLM activities are simply by taking counts of land users adopting three sustainable and climate-smart/resilient land management practices on individual land practiced for more than five years since the positive effects of soil and water conservation (SWC) may occur through time and adoption of SWC agricultural technologies depends on the ability of the technologies to improve agricultural land productivity and income, and risk decisions facing individual households both in short and long term (Yitayal et al., 2014).

The sampling frame was the list of households obtained from agricultural office of each selected kebele (see Table 2). The sample size was determined based on Yamane (1967) formula at 95% confidence level, degree of variability = 0.5 as follows.

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

Where n is the sample size, N is the population size (total household size), and e is the level of precision. N had been taken from the total household numbers of the sampled kebeles.

$$n = \frac{1679}{1 + 1679(0.05^2)} = \frac{1679}{1 + 1679(0.0025)} = \frac{1679}{1 + 4.2} = 322$$

3.2.3 Method of Data Collection

Primary data had been collected through semi-structured questionnaires most of which was structured but for some of it was unstructured open-ended questionnaires namely schedule method. According to Kothari (2004), schedule method of data collection is very much like the collection of data through questionnaire, with little difference which lies in the fact that schedules (Performa containing a set of questions) are being filled in by the enumerators who are specially appointed for the purpose. These enumerators along with schedules go to respondents, put to them the questions from the Performa in the order the questions are listed and record the replies in the space meant for the same in the proforma. So in general the data for this study was collected through questionnaires using enumerators the researcher himself.

3.2.3 Method of Data Analysis

For this study both descriptive statistics and econometric models had been applied to analyze the collected data.

3.2.3.1 Descriptive analysis

First, the status of participation (adoption of SLM activities) of sample households in SLM activities had been described through GIZ SLM standards of sustainability of land resource management activities on household plot in descriptive way by comparing means and variations. Accordingly, the t-test is used to test the significance of continuous variables while chi-square test is used to test the significance of the potential dummy variables.

The second objective which focuses on the determinants of farmers' participation and practice of those SLM activities had been analyzed through descriptive statistics with binary logit model, as the outcome variable, the SLMP participation status of households, is a categorical variable with two discrete values. As stated above the participants are the households who practiced SLM activities (at least three climate resilient SWC activities in their farm) for five years and above and the non-participants were who are lived in the intervention kebele and watershed but not practiced SLM activities in their farm land for the same years as participants.

The data collected from sample households was analyzed by using both descriptive statistics and econometric analysis. Descriptive statistics like mean and percentages were used to examine and understand the socio- economic situations of the sample households. Moreover, t-test and chi-square test were used to compare users and non-users in terms of different explanatory variables. While econometric analysis (logit model) was used to identify the determinants of participation of SLM activities. Endogenous switching regression (ESR) model was used to analyze the impact of participating in SLM activities on farmers' income. For this study, income of households (evaluated at market price of survey period) used to measure their livelihood status. For quantitative analysis STATA 14.1 software was used as tool of analysis.

3.2.3.2 Econometric Analysis

This study pursued to examine the impact of land resource management activitis on farmers' livelihood by examining income of respondents as an outcome variable using Endogenous switching regressions model specified below.

Contrasting, the previous studies those have been conducted in Ethiopia by using propensity score matching; the study attempts to address the self-selection bias by using outcome indicators to measure the livelihood implication of SLM participation using endogenious switching regression model.

Endogenous switching regressions model

The impact studies seek to determine the effectiveness of a particular intervention. In economic policy analysis, researchers rarely can work with experimental data generated by purely random assignment of subjects to the treatment and control groups (Baum 2013). Christopher added that in non-experimental economic data, we observe whether subjects were treated or not, but in the absence of random assignment, must be concerned with differences between the treated and non-treated.

The main issue in impact evaluation is that of missing data. Subjects cannot be observed in both statuses at the same time, that is participation in land management activities and non-participation in the project is mutually exclusive. In the absence of data on counterfactual outcomes that is outcomes for project participants had they been non participants, the impact evaluation problem becomes that of missing data. Unless the SLM project participation was randomized, the missing data is not random (Cuong, 2007). Participants select into the project based on their decisions and project administrators' decisions, implying that project participation is non-random. Impact evaluation can be rigorous in identifying project impacts by using different models to construct comparison groups for participants (Khandker et al., 2010).

In the study area, the interventions of SLMP were not randomly distributed and the decision to participate in SLM activities is voluntary. Therefore, it should be emphasized that

smallholder farmers may self-select themselves as the SLM activities participant. In this regard, they use SLM activities, if they perceive that SLM activities will provide them with more income and asset than non participants. Hence, it is not possible to directly compare income of the participants and non-participants households because of selection bias. This selection bias may result from both observed (observed to the researcher) and unobserved (observed to the respondent but not the researcher) characteristics. According to Alene & Manyong (2007), self-selection into an intervention utilization would be the source of endogeneity, and failure to account this bias would obscure the true impact of the intervention.

The major econometric problem in evaluating project impacts is selection bias (Maddala, 1983). Instrumental variables or statistical control methods, in which one uses one or more variables which matter to participation, but not to outcomes given participation. This identifies the exogenous variation in outcomes attributable to the program recognizing that its placement is not random but purposive. Measuring the impact of the program when treatment has not been randomly assigned is by using the instrumental variable (IV) method. The IV estimation regards the treatment variable as endogenous. The idea is to find an observable exogenous variable or variables (instruments) that influence the participation or selection variable but do not influence the outcome of the program if participating (Khandker et al., 2010).

Selection bias arises from the fact that treated individuals may differ from the non-treated for reasons other than treatment status. SLM activities participants usually purposively targets the dwellers of some specific watersheds or kebeles, which are more likely to be poor . It is expected that participants would have had far less income in the absence of the project.

Selection bias could be as a result of selection on observables or unobservable. Selection on observables can be controlled by including all the variables in the model. Selection on unobservable is difficult to control by adding these variables as these variables aredifficult tocapture and not observed. Variables such as managerial ability, motivation, propensity to bear risks, etc., are some examples of variables that are hard to capture.

Selection bias can be overcome in three ways using instrumental variables, using panel data, or by assuming normality in the error distribution of the outcome variable before the treatment happens (Moffitt, 1991). Furthermore Holvoet (2005) recommended minimizing selection bias by gaining a good understanding of the subject under study and potential selection processes, which can help identify the persistent matching characteristics of participants and nonparticipants and controlling of other differences statistically. As a result, we looked at characteristics related to households, such as socioeconomic status and whether the household is participants or not, and whether program placement strategies is non-random or random. In this study, the endogenous switching regression model is used to minimize the problems of self-selection bias and unobserved characteristics.

ESR designs account for both endogeneity and sample selection bias by estimating a simultaneous equations model using full information maximum likelihood method (Lokshin & Sajaia, 2004). Moreover accounting for selection bias arising from unobserved factors that potentially affect both the decision to use SLM activities and the outcomes, it controls for structural differences between the participants and non-participants regarding the outcome functions (Alene & Manyong, 2007).

Therefore, the main significance of ESR is that it allowed us to control both selection and unobserved heterogeneity issues that may arise onwards doing the basic estimation procedure (Lokshin & Sajaia, 2004). Previous empirical studies have employed the framework to study the impact of an intervention on household livelihood and poverty (e.g. Owusu et al., 2011; Kuwornu and Owusu, 2012; Gebrehiwot et al., 2017).

Following Lokshin & Sajaia (2004),in this approach, there are two stages, first the decision to use SLM activities (selection equation) is modeled by standard limited dependent variable models, and second the outcome variables are then estimated separately for each group (as SLM activities participants and non-participants), conditional on having the selection equation. Therefore, the selection equation is a dichotomous choice, where a smallholder farmer decides to participate SLM activities when there is a positive perceived difference between having participation and not having the participation. Consider a farm household **i**

that faces a decision on whether or not to participate. Let the indicator variable be **Si** taking a value of 1 for households who decided to participate and 0 otherwise.

This leads to two possible states of the world: a decision to participate in SLM activities (**Si**=1) and not to participate (Si=0), and two population units: SLM activities participants and non participants.

Let's denote the benefits to the household of participating SLM activities (U1) and the benefits of the household not participating SLM activities (U0). Under a non-random utility framework, a rational farm household will choose to use SLM activities if the benefit of participation is positive i.e. $\mathbf{U_1}>\mathbf{U_0}$ or $\mathbf{U_1}-\mathbf{U_0}>\mathbf{0}$.The net benefit ($\mathbf{U}* = \mathbf{U_1}-\mathbf{U_0}$) is represented by a latent variable.

Conditional on households' decision to use SLM activities denoted by a selection function ($\mathbf{S_i}$), there are two potential outcomes to the two population units: the outcome of the participants ($\mathbf{L_1}$) and the outcome of the non-participants ($\mathbf{L_0}$). This can be put in a potential outcome framework as:

$$L_i = (1 - S_i)L_{0i} + S_i L_{1i}$$

$$L_i = \{L_{1i} \text{ if } S_i = 1 \; L_{0i} \text{ if } S_i = 0\}$$

The gain from the intervention is provided as $L_1 - L_0$. Hence, taking a simple difference and averaging cannot give the effect of the intervention, causing a 'missing data' problem (Heckman et al; 2001). Therefore, following Lokshin & Sajaia (2004) the selection equation as latent variable framework can be expressed as:

$$S_i * = \beta Z_i + V_i \quad \text{..... (1)}$$

$$S_i = \{1 \; if S_i * > 0; 0 \; if S_i * \leq 0\}$$

Conditional on selection, the outcomes are represented as follows:

$$L_{1i} = \{Y_{1i} = \alpha_1 x_{1i} + \varepsilon_{1i} \text{ if } S_i = 1\} \quad \text{..... ..... (2)}$$

Where Z are vectors of observed characteristics that determine the selection equation (includes household, demographic, socioeconomic and farm characteristics); x_{1i} and $x_{2i}$are vectors of explanatory variables assumed to be weakly exogenous and determine the outcomes of participants and non-participants. Although, Z and X can overlap, but there must be at least one variable in Z is required not to be included in X to properly identify the outcome equations and α1, α2 and β are vector of unknown parameters to be estimated. The L_{1i} is income indicator (outcome variable), in this case, income is an outcome variable. According to this study, income (Y) Y_{1i} represents income of the SLM activities participants. whereas, Y_{2i} is income of the non-participants respectively. The error terms of the continuous outcome equations (ε_1) and selection equation(v_i).

Following Foltz (2004), this paper, first assume that the unobserved residual effects of the selection equation are independent of unobserved residual effects of the outcome equations. That is

$$E[\varepsilon_{1i}|S_i = 1] = E[\varepsilon_{2i}|S_i = 0] = 0$$

$$cov\ (\ v_i, \varepsilon_i\ ) = 0$$

This implies that sample partitioning between the participants and non-participants is entirely exogenous to their behavior so that an exogenous switching structure results. The unconditional expectation of these models can be expressed by Applying ordinary least squares to give consistent estimate of the α.

$$E(L_{1i}|\ x_{1i}) = \alpha_1 x_{1i} \quad \text{.....} \quad (3)$$

$$E(L_{2i}|\ x_{2i}) = \alpha_2 x_{2i} \quad \text{.....} \quad (4)$$

However, there is a high likelihood that uncontrolled factors (for example, expectation of yield gain from practicing SLM activities, risk taking ability, managerial skills, and/or motivation) simultaneously influencing the selection equation and the level of outcomes, so that cov (vi, εi) ≠ 0. Under this scenario sample separation between the SLM activities participants and non-participant households become endogenous to their behavior and

governed by selection equation regime.Here, the paper assumed a trivariate normal distribution of error terms, with zero mean and a covariance matrix represented by Σ i.e. (v, ε1 ,) ~ (0, Σ). Further justification, the error term v of selection equation is correlated with the error terms ε1 of outcome equations. Accordingly, the expected values of ε1 would be non-zero conditional upon the selection equation. This makes ordinary least square estimates to be more biased. The covariance matrix Σ is expressed as follows:

$$cov(v_i, \varepsilon_1) = \{\sigma v\ 2\sigma_1 v\ \ \sigma_2 v\ \ \sigma_1 v\ \ \sigma_{12}\ .\sigma_2 v.\sigma_{22}$$

Where var (v_i) = σv_2 is the variance of the error term in the selection Eq. (1), var (ε_1) = σ_{12} and var (ε_2) = σ_{22}, are the variances of the error terms in the outcome functions Eq. (2) and (3) respectively, and cov (ε_1 ,v_i) = $\sigma_1 v$, cov (ε_2 ,v_i = $\sigma_2 v$). Whereas, the cov (ε_1,ε_2) is not defined, as L_1 and L_2 are never observed simultaneously (Lokshin & Sajaia, 2004) . σv_2=1, because β is estimable up to a scalar factor (Maddala, 1983).

The endogeneity can be tested with estimates of the covariance terms. If $\sigma_1 v = \sigma_2 v = 0$, one has a model with an exogenous switching; on the other hand, if either σ1v or σ2v is non-zero, one has a model with an endogenous switching (Maddala ,1986).Consequently, significance of the correlation coefficients between ε_1 and ($v\rho\varepsilon_1 v = \sigma\varepsilon_1 v_2/\sigma\varepsilon_1\sigma v$ and between ε_2 and v ($\rho\varepsilon 2v = \sigma\varepsilon 2v\ 2\ /\sigma\varepsilon 2\sigma v$) needs to be tested (Lokshin & Sajaia, 2004).

Not that; in line with standard statically arguments, $\rho\varepsilon_1 v$ and $\rho\varepsilon_2 v$ must lie between -1 and 1, and σ_{1v} and $\sigma_2 v$ must be always positive/Based on the argument on the distribution of disturbance terms, the logarithmic likelihood function can be formulated following the procedure by (Lokshin & Sajaia, 2004) whom they depend their derivation on (Maddala, 1983).

$$\boldsymbol{lnL} = \sum(\boldsymbol{S_i}\, w_i[\boldsymbol{ln}\{\boldsymbol{F}(n_{1i}\} + \boldsymbol{ln}\left\{\frac{f^{\frac{\varepsilon 1 i}{\sigma 1}}}{\sigma 1}\right\}] + (1 - \boldsymbol{S_i})\, w_i\, [\boldsymbol{ln}\{1 - \boldsymbol{F}(n_{2i}\} + \boldsymbol{ln}\{\frac{f^{\frac{\varepsilon 2 i}{\sigma 2}}}{\sigma 2}\}]$$

Where F (.) is a cumulative normal distribution function, f (`) is a normal density distribution function w_i is an optional weight for observation i, and

$$n_{ji} = \frac{(\beta z_i + (\frac{\rho_j \varepsilon_{ji}}{\sigma_j})}{\sqrt{1-\rho^2 j}}$$ Where j =1, 2

In addition to the endogeneity test, $\rho\varepsilon_1 v$ and $\rho\varepsilon_2 v$ provide economic interpretation depending on their signs. If $\rho\varepsilon_1 v$ and $\rho\varepsilon_2 v$ have opposite signs, households decide whether to have participation or not based on a comparative advantage (Fuglie & Bosch, 1995; Maddala, 1983). That is, participants enjoy above average income once having participation whereas, non-participants enjoy above income when not participate. Alternatively, if $\boldsymbol{\rho_{\varepsilon 1 v}}$ and $\boldsymbol{\rho_{\varepsilon 2 v}}$ have the same signs, it demonstrates "hierarchical sorting" (Fuglie & Bosch, 1995), suggesting that the participants income is above the average level whether or not they have participated but get better off having than not having. Similarly, the non participating's income is below the average level in either case but get better off choosing not having participation. Moreover, the coefficient $\rho\varepsilon_1 v$ and $\rho\varepsilon_2 v$ can give evidence for model consistency under a condition $\rho\varepsilon_1 v < \rho\varepsilon_2 v$ (Trost, 1981). This implies that participants enjoys more income level than they would if they did not have participation.

The key issue in controlling for the endogeneity of the selection equation is identification of instrumental variables. It is necessary of finding instrumental variables that could be strongly correlated with the selection equation (Eq. 1) but not the outcome (income) equations (Eq.2 and 3). From the variables in our data set, this study uses distance from household's residence to the farm land and social participation that is being memember of watershed users association as instrumental variablesare properly identify the model. In developing countries, social networks, peasant and cooperative association, friends are the main source of information and confidence in the process of technology or new practice. Hence the existence of social participation (farmer –to- farmer contact) is expected to influence to practice SLM activities. but not the income of households. Following (Di Falco et al;2011), the validity of the selection instruments was tested. According to his argument, a variable is a valid selection instrument, if it will significantly affect the selection variable but it will not affect the income households that did not participate in SLM activities.

The average treatment effect on the treated (ATT) and untreated (ATU) were computed by comparing the expected values of the outcome of the participants and non-participant

households in actual and counterfactual scenarios. The estimates from endogenous switching regression allow for the computing of the expected values in the real and hypothetical scenarios: Following model estimation, Stata allows calculation of the following conditional expectations (Lokshin & Sajaia, 2004).

Actual expected outcome: SLM participants

$$E(L_{1i}|\, S = 1, x_{1i}) = \alpha_1 x_{1i} + \sigma_1 \rho_1 \mathrm{f}(\beta)/\mathrm{f}(\beta_{Zi}) \quad \text{..... (5)}$$

Counterfactual expected outcome: SLM participants

$$E(L_{1i}|\, S = 0, x_{1i}) = \alpha_2 x_{1i} - \sigma_1 \rho_1 \mathrm{f}(\beta_{Zi})/\{1 - \mathrm{f}(\beta_{Zi})\} \quad \text{..... (6)}$$

Counterfactual expected outcome: SLM non-participants

$$E(L_{2i}|\, S = 1, x_{2i}) = \alpha_1 x_{2i} + \sigma_2 \rho_2 \mathrm{f}(\beta_{Zi})/\mathrm{f}(\beta_{Zi}) \quad \text{..... (7)}$$

Actual expected outcome: non-participants

$$E(L_{2i}|\, S = 0, x_{2i}) = \alpha_2 x_{2i} - \sigma_2 \rho_2 \mathrm{f}(\beta_{Zi})/\{1 - \mathrm{f}(\beta_{Zi})\} \quad \text{..... (8)}$$

Equation (Eq. 5) and (Eq. 8) represent the actual expectations observed from the sample, while (Eq. 6) and (Eq. 7) are the counterfactual expected outcomes. Given the above formulation, the following mean outcome difference can be calculated and compared. The expected change of SLM participants that means the effect of treatment on the treated (ATT) is computed as the difference between Eq. (5) and (6):

$$ATT = E(L_{1i}|\, S = 1, x_{1i}) - E(L_{1i}|\, S = 0, x_{1i}) \quad \text{..... (9)}$$

Similarly, the expected change in the non-participants, the effect of the treatment on the untreated (ATU) is the difference between Eq. (6) and (8):

$$ATU = E(L_{2i}|\, S = 1, x_{2i}) - E(L_{2i}|\, S = 0, x_{2i}) \quad \text{..... (10)}$$

The treatment effects can be differentiated from the heterogeneity effect because the presence of unobservable characteristics. Therefore, "the effect of base heterogeneity" (BHu) for the group of households that decided to use SLM activities is defined as the difference between (Eq.5) and (Eq.6):

$$BH\text{u} = E(L_{1i}|\, S = 1, x_{1i}) - E(L_{1i}|\, S = 0, x_{1i}) \quad (11)$$

Similarly, "the effect of base heterogeneity" (BHN) for the group of households that decided to not to use SLM activities is defined as the difference between (Eq.7) and (Eq.8)

$$BH_N = E(L_{2i}|\, S = 1, x_{2i}) - E(L_{2i}|\, S = 0, x_{2i}) \quad (12)$$

Finally, the effect called "transitional heterogeneity" (TH), estimates whether the effect of working SLM activities in thier own land is larger or smaller for households that use SLM activities or for the households that did not use in the counterfactual case that they did use. It is the difference between (Eq.9) and (Eq.10), i.e. (ATT) minus (ATU):

TH = ATT – ATU ..... (13)

Table 3 Conditional expectations, treatment and heterogeneity effects

Sub-samples	Decision stage		Treatment effect
	To participate in SLM activities	Not to participate	
HHs participated in SLM	(a) $E(L_{1i}|\, S_i = 1)$	(c) $E(L_{2i}|\, S_i = 1)$	ATT
HHs not participated	(d) $E(L_{1i}|\, S_i = 0)$	(b) $E(L_{2i}|\, S_i = 0)$	ATU
Heterogeneity effects	Bhu	BH_N	TH

Note :(a) and (b) in table 3 represents observed expected income of participants and non-participants ;(c) and (d) represents counterfactual of participants of SLM activities.

3.3. Definition of Variables and Hypothesized Relationships

3.3.1 Description of the dependent and outcome variables

The endogenous switching regression model is simultaneously determined the selection and outcome equations. The dependent variables of this model is the selection variable which is participation decision in three SLM activities in thier land by thier intiative for more than five years is a dummy variable taking a value one if the household participates and zero otherwise.

Income (Y) is the other outcome variable used in this model that represents the amount of income the farmer or any of the household members earned (in cash or in kind) from their farm production and non-farm income (including off farm incomes since one of the intervention is IGA in SLMP). It is measured by the amount earned per year from those sources in Ethiopian birr.

3.3.2. Description of Independent Variables

The independent variables that are hypothesized to affect the farmers' decision to participate in SLM activities and level of income are combined effects of various factors such as: demographic, socio-economic and institutional factors in which smallholder farmers operate are hypothesized to explain in the study area. Based on past research findings, that affect the decision to participate in SLM activities and both outcome variables used for this study, are presented as follows:

Age of the household head (AGEHH) : It is continuous variable measured in years. Age of a household head can generate confidence on new technologies. According to Motamed & Baldev (2003), young people are more flexible in deciding for change than aged people. Therefore, at younger ages the probability to participate in SLM activities will increase and simultaneously, increase income. On the other hand, as the farmer gets older and older his managerial ability and physical capacity are expected to decrease as a result the overall labor hours will decline and the demand for leisure will increase and older the household head the less inclined he is to adopt new technologies (Phoeb et al; 2000).

Marital status of the household (MARHH): which refers to households wether married or single. Maried households expected to be participated in SLM activities due to labour division and stability of the household.

Adult Labour (ADULTEQUI): It refers to active family members of a household. Availability of labor is likely to influence the gross margin of different technology innovation. This indicates that households with large number of active family members will supply more labor for different activities and want to diversify their capital need. Therefore, a farm with larger number of workers is more likely to be in a position to continue using a potentially profitable innovation technology. Therefore, it is hypothesis that, adult labour positively influences the decision to to participate in SLM activities, and to have income.

Education Level of the household head (HHEEDUCA): It is a dummy variable, which takes 1 if the respondent can read and write, 0 otherwise. Educated farmers would more readily adopt SLM technologies and may be easier to train through extension support. Therefore, to participate in SLM activities needs technical knowhow, head of the household need to read and understand some SLM techniques. Therefore, increase in education level increases smallholder farmers' ability to obtain, process, and use information relevant to the to participate in SLM activities. Thus, it is hypothesized that literate household heads are more likely to to participate in SLM activities and expected to have a positive relationship with household .

Size of own cultivated land (LANDSIZE): It refers to the total cultivated land size of a household ; a continues variable measured in hectare. This means that those households having more cultivated land are active to adopt new technology and want to diversify their farming activities. As most of the households in the study area are smallholders, one of the possible ways to increase their output is by intensive farming. Hence, this variable is hypothesized to have a positive effect on participating in SLM activities and increases households income.

Distance to the farm land (DSFLD): This variable is a continuous variable measured in kilometers. Distance of the households to the farm land is expected to determine the

household's to participate in SLM activities. The residence of households nearby farm land is expected to have positive relation to the probability of to participate in SLM activities. The nearer the households residence to a farm land, the higher the probability he/she has to to participate in SLM activities, due to the fact that the opportunity cost of time lost in travelling to and from and farm land for households. Hence, it is expected that the distance of residence from the household and to participate in SLM activities are negatively related.

Membership of watershed users association (WUA): This is a dummy variable with 1 for participated and 0 otherwise. Farmers Participation and membership in different community organization assume that farmers who have some position in rural kebele's and different cooperatives are more likely to be aware of new practices as they are easily exposed to information. Farmers being a membership of watershed users association assume that more likely to be aware of new practices as they are easily exposed to information (Habtemariam Abate, 2007). Therefore, hypothesized that those farmers who participated in some social organization as a member or leader are more likely to participate in SLM activities and are positively related but no effect on income.

Access to credit and saving institutions (SAVCRE): This is a dummy variable with 1 for participants and 0 otherwise. Those households, who have saving and credit user, spend on activities they want. Either they purchase agricultural input (improved seed, fertilizer, etc.,) or they purchase livestock for resale after they fattened them. All these activities increase income of the household. Previous research result reported by Tesfaye & Alemu (2001) confirmed that access to credit positively influence adoption of technology. Those households who have access to credit became capable of using SLM activities than those who have no access to credit. Hence, it is expected that, access to credit would have a positive relation with the to participate in SLM activities, and increases income.

Livestock owned (TLU): Livestock is the farmers' important source of income, food and draft power for crop cultivation. Hence, a household with large livestock holding can have good access for more draft to take its product market. Like many other similar studies, it was measured in terms of Tropical Livestock Units (TLU) developed by Storck et al.(1991).Livestock are source of income for farming households through sales and income

generation for any possible spending in the use of technologies. Previous research result reported by Tesfaye and Alemu (2001) confirmed that livestock holding have positive influence on technology adoption. The positive relationship indicates that households with larger livestock holding may have money to spend on any possible cost to adopt technology. Therefore, it is expected that, total livestock owned and participating in SLM activities are positively related.

Distance from the nearest market (DISTMRKT): This is continuous variable that measured in kilometers. Easily access of market is important to buy input and/or to sell output as well as to purchase food and nonfood products a swell as different echnologies and tools. The closer the respondents to the market, the more likely it is that they will receive valuable information (Gecho & Punjabi, 2011).The farther the households home to the nearest market the lesser the income from the sale of farm produce, especially perishable commodities may perish before arriving the market if the distance is too far. Hence, to avoid such incidences, the farmer may sell his output to the neighbor traders for cheaper price, that reducing his income. Therefore, distance from nearest market is hypothesized to influence negatively the farmers' decision to participate in SLM activities, and having higher income.

frequency of extension contact of the household (FRQEXT): This refers to the number of contacts the respondents made with extension agents with in a year. The effort is to disseminate new and improved agricultural practices within farmers. This means farmers, who have frequent contact with extension agents, can develop their knowledge and decision making ability to easily adopt new technologies and technical skills. Therefore, it is hypothesized that the number (frequency) of extension contact positively influences the decision to participate in SLM activities and increasing annual income.

Paied land management activities participation (PLMAP): this variables refers to households which are participants or beneficiaries in work to food programmes by participating in communal land land resource management activities intervened by both either in government programs like productive safetynet progrma or in non government programs like sustainable land resource management programmes and Care ethiopia in the study area.

The above mentioned variables identified and thier expected sign had been summerized in table 4 below.

Table 4. Identified variables and expected signs of participation decision

No	Variables	Variable Code	Types of variables	Statistics	Expected sign
1	Income of the household (outcome variable)	TOTALINCM	Continuous	Compare means	
2	Land resource management participants ≥3 SLM activities (dependent variable)	PARTCPNT	Dummy	``	+
3	land size in hectare per hectare	LANDSIZE	Continuous	``	+
4	Marital status of the household	MARHH	Dummy	``	+
5	Number of livestock per house hold,	TLU	Continuous	``	+
6	age of household head,	AGEHH	Discrete	``	-
7	educational status of household head,	HHEDUC	Dummy	``	+
8	household size,	HHsize	Discrete	``	+
9	Saving and credit access	SAVCRE	Dummy	``	+
10	Extension service	FRQEXT	Discrete	``	+
11	Adult equivalent	ADULTEQUI	Continuous	``	+
12	Membership of watershed users association	WUA	DUMMY	``	+
13	Distance of Households residence to the farmland	DSFLD	Continuous	``	-
14	Paied land management activities(PLMAP) participation		DUMMY	``	+

Source: own survey 2018

4. RESULTS AND DISCUSSION

This Chapter presents and discusses the results on the socio-economic characteristics of rural livelihoods, determinants of household participation in sustainable land resource management and analysis of the impact of sustainable land resource management on households' income. Section 4.1 provides the descriptive analysis of model variables (objective and two), section 4.2, deals with econometric analysis logit regression and ESR models.

4.1 Demographic and Socioeconomic Characteristics of Households

Descriptive analyses of selected demographic and socioeconomic characteristics of sample households are discussed below.

4.1.1 Demographic Characteristics

Status of land resource management participants by sex:

Land resource management participants	Sex of HH head						x^2
	Female		Male		Total		
	No	%	No	%	No	%	
Participants	14	19.17	147	59.03	161	50	35.87***
Non participants	59	80.83	102	40.96	161	50	
Total	73	100	249	100	322	100	

Source: own survey of 2018

As indicated in table 5; 161 respondents which are 50% were participants of sustainable land resource management activities and the other 161 or 50% of respondents were not participants or users. Among 73 female respondents 19.17% of them were participants and the remaining 80.83% of them were non participants. This tells us other things remaining constant being female headed household are tends to be non-users or participants of land resource management activities in their own land. The chi-square test indicates that sex of HH s head had a significant relationship to sustainable land resource management at 1% significance level. The average age of the sample household heads is 44.55 years with standard deviation of10.78.The average family size of the sample households is 4.57 persons with a standard deviation of 1.79. The family size of the sample households ranges from 1 to 8 persons.

Table 5 status of land resource management participants by sex

Educational status of respondents

Table 6 Educational status of respondents

Level of education	Land resource management participants N=322						x^2 test
	Non Participants		Participants		Total		
	No	%	No	%	No	%	
Illiterate (no read and write)	59	36.64	76	47.2	135	41.92	24.95***
1-4	67	41.61	77	47.8	144	44.7	
5-8	3	1.86	4	2.48	7	2.1	
9-10	18	11.18	3	1.86	21	2.17	
11-12	14	8.69	1	0.6	15	4.65	
Total	161	100	161	100	322	100	

Source: own survey 2018

The results of the study are similar with that of Meshesha et al (2018); where the majority of the people who participated in SWCP or SLMP were illiterates. Among 161 participants 47.2% of them were illiterate respondents. When we compare the illiterate groups there is some negative differences between participants among the non-participants 36.64% of them were illiterate.

As illustrated in table 6 below the participated group who enrolled from grade 1-4 was 47.8% and the non-participant group was 41.61%. While the respondents who educated from grade 5-8 were 2.48 and 1.86 for participants and non-participant groups of land resource management activities respectively; and when we compare to grade 9 and 10 respondents 1.86 and 11.18 respectively.

Some demographics and socio economic characteristics of the sample households of sustainable land resource management participants and non-participants with comparison group are presented in (Table 7 and Table 8) for continuous and categorical variables,

respectively. The sample under consideration is composed of 161 (50%) participants and 161 (50 %) non-participant households.

Summary statistics for continuous variables of the Household characteristics

Table 7 Summary statistics for continuous variables of the Household characteristics

Variables	Non participant (N=161) Mean	Participant (N=161) Mean	Combined (N=322) Mean	Differences Mean	t-test
AGEHH	41.45	47.65	44.55	-6.1	-5.3752**
	(.90)	(.71)	(.60)	(1.15)	
HHsize	3.96	5.17	4.57	3.07	-6.3762***
	(.15)	(.10)	(.10)	(.133)	
ADULTEQUI	3.46	4.55	4.01	-1.09	-5.9486***
	(.15)	(.10)	(.18)	(.18)	
LANDSIZE	0.82	1.15	.99	.332	-6.7564***
	(.03)	(.029)	(.026)	(.049)	
DSFLD	3.34	0.94	2.14	2.3	13.2651***
	(.13)	(.11)	(.11)	(.18)	
TLU	0.80	2.08	1.44	-1.28	-13.9627***
	(.061)	(.068)	(.058)	(.092)	
DSTMRKT	3.16	2.78	2.97	.38	1.2421
	(.23)	(.19)	(.15)	(.30)	

*** p<0.01, ** p<0.05, * p<0.1 represents levels of significance. The values in the parenthesis are standard errors. Source: Computed from own survey data (2018)

The average age of household heads of sustainable land resource management participants is nearly 47.65 years while that of the non-participants is approximately 41.45 years (Table 7). The mean comparison test shows there is statistically significant difference at 5% significance level in the distribution of household head age between participants and non-participants household heads.

In the study area, the average household size of the treatment group (sustainable land resource management participant) was 5.17 and control group (non-participants) was found to be 3.96.

The mean comparison test shows that there is significant difference 1% significance level in household size between participants and non-participant groups.

Adult labor of the sustainable land resource management participants was approximately 4.55 compared with the non-users 3.46. The size of labor force in the household is expected to contribute for variation on participation decision in soil and water conservation and level of income and it is significant at 1% significant level.

Cultivated land appears to be the most important scarce factor of production. In the study area, own land, rented and shared lands was used for cultivation. The average owns cultivated land holding of the sampled households was 0.99 hectare. In comparing with the participant and non-participant, the average cultivated land size of the participants was 1.15 ha and the non- participants was 0.82 ha (Table 7). The difference is 0.332 hectare and it had significant at 1% significance level. According to the respondents report, in the study area, own land, rented land, shared cropping lands and gift lands are a common practice of farming. Shared cropped land and rented land are mainly done through contractual arrangements to share the harvest and tends to occur when the owner of the land cannot cultivate by himself/herself. Mostly, the agreement is for a short temporary period (e.g. one year or two to three years) on the basis of money (rented) or different crop sharing agreements.

As per the study the mean TLU for participants of land resource management is 2.08 and 0.80 and having more livestock is significant in 1% for participation decision (table 7).

When we see distance of households land from market in comparison with sustainable land resource management status, the non-participants are located far away from the market with an average distance of 3.16 km compared to participants 2.78 km.

Summary statistics for categorical variables on household by participating in SLM activities

Table 8 Summary statistics for categorical variables on household by participating in SLM activities.

Variables	Categories	Non participants (N=161)	Participants (N=161)	Combined (N=322)	X^2-test

		Frequency	Frequency	Frequency	
EXTFRQ	Weekly	1	0	1	46.51***
	Bi-weekly	12	17	29	
	Monthly	79	128	207	
	Once a year	44	10	54	
	Other	25	6	31	
HHEDU	Could not read and write	59	76	135	24.95***
	could read and write	102	85	187	
MARHH	Single	92	12	104	90.89***
	Married	69	149	218	
SAVCRE	Non-user	118	19	137	124.51***
	user	43	142	185	
WUA	Non- member	132	20	152	156.31***
	Member	29	141	170	
PLMAP	No	136	48	184	98.20***
	Yes	25	113	138	

*** p<0.01, ** p<0.05, * p<0.1 represents levels of significance.

Source: Computed from own survey data, (2018)

Access to information is one of the vital factors in adoption of technologies. The source of farm technology information in the study areas are both government bodies especially development agents; and non-government organizations like Action Aid and SLMP GIZ promoters.

As revealed in the Table 8; there is a relationship between frequency of extension delivered to the farmers and decision to participate or practice land resource management activities in their own land. The chi-square test indicates that frequency of extension had high correlation to sustainable land resource management at 1% significance level.

It is widely believed that education level of household heads is a decisive factor in affecting the adoption of technologies and improving agricultural productivity and in this research chi-square test revealed that there is no relationship between education level and use of soil and water conservation activities at 1 % significance level (Table 8).

Both saving and credit is the main source of finance for poor farmers to purchase input and ultimately to adopt new technology. The main source of credit in the study area is Amhara Credit and Saving Institution (ACSI) and saving and credit cooperatives. The survey revealed that 57.45 % of the sample households take credit. The comparison by land resource management participants, the survey result revealed that 44.09% of the land resource management participants and 13.35 % of the non-participants had utilized credit, while 5.9 % of participants and 36.64% of the non-participants did not take credit and not participated in saving. The chi-square test revealed that significant relationship between access to credit and use of sustainable land resource management users at 1 % significance level (Table 8).

Farmers Participation and membership in different community organization assume that farmers who have some position in rural kebele's and different cooperatives are more likely to be aware of new practices as they are easily exposed to information. The survey revealed that 75.15 % of the sample households actively participate in watershed users association. About 97.3% of land resource management users participated in different community organization as leader, committee members and members. The chi-square test revealed that there is a significant relationship between social participation and use of sustainable land resource management at 1 % significance level.

Main income sources

Mean estimation of household income over sustainable land resource management

Table 9 Mean estimation of household income over sustainable land resource management participation Number of observations = 322

Income type	Mean (ETB)	Std. Dev.	Min (ETB)	Max (ETB) t-test
Crop income (322)	59760.54	53499.81	2400	694800
Participants (161)	81336.91	3383.211		
Non participants (161)	11159.22	1220.911		
Live stalk income (322)	20246.58	20831.56	0	254650
Participants s (161)	27095.75	1421.447		
Non participants (161)	4818.636	735.3638		
Nonfarm income (322)	10944.53	4726.691	0	25400

Participants (161)	10885.13.54	4533.385			
Non participants (161)	11003.93	388.2			
Total income 322	91052.61	63659.95	4500	722250	-3.7960***
Participants (161)	104246.7	3120.823			
Non participants (161)	77858.5	6211.514			

Source: own survey 2018

The average total annual income of the household is 91052.61 with the standard deviation of 63659.95 and it is due to one outlier. When we compared between sustainable land resource management participants and non-participants, participants' average total annual income is 104246.7 and the non-participants were 77858.5 with the standard deviation of 3120 and 6211 respectively. Since the average total annual income is the sum of the average of crop, live stalk and non-farm income; the reason for the difference is differences in those income components. The minimum average live stalk and nonfarm annual income of non-users were 0 birr and 2400 birr of crop income (table 9).

The average crop annual income of participants and non-participants had a difference. It was 27095.75 and 4818.636 respectively for participants and non-participants. The mean difference was 22277 birr. The standard deviation of annual crop income for participants is 3383.211 and 1220.911 for non-participants. To compare the mean annual incomes based on the income sources crop income holds 65.63%, income from live stalk sources shared 22.23%, and nonfarm income sources shared 12%.

4.1.2 The status of sustainable land management practices

The overall status of sustainable land management practices are discussed in the type of practices, land sizes, age of the house hold, adult equivalent, age of the house hold, marital status of the household, household size, house hold education, iqub, watershed users association, participation in cooperatives, saving and credit, households ownership of oxen, , household live stalk income, household crop income, estimated annual non-farm income of the house hold, frequency of extension delivered to the households.

4.1.2.1 Sustainable land management activities in the study area

Table 10 Sustainable land management activities practiced in the study area

S.no	Land management activities practiced	N=322	%
1	Soil bund	224	69.56
2	Stone faced soil bund	224	69.56
3	Biological treatment on bunds and terraces	218	67.7
4	Terracing plus water collection trench	185	57.4
5	Manure application	233	72.3
6	Artificial fertilizer	259	80.4
7	Crop rotation practice	276	85.7
8	Fallowing	195	60.55
9	Other (ridges)	7	2.17

Source: own survey 2018

As per table 10 above there are about 9 different soil and water conservation; and soil fertility management activities practices in the study area. The study is conducted for farmers practiced those management activities for their all plots. The first four activities are the physical and biological soil and water conservation activities. The other 4 activities are a type of land resource management mainly for soil fertility management.

69.56% of respondents practiced both soil bund and stone faced soil bund at least in one plot out of their whole plots. According to the respondents, stone bund construction is labor intensive and it is limited to areas where there is stone on the farm plot. Stone bund is constructed to capture the soil washed down by flood from steep and mountainous slopes where the use of other types of soil conservation technologies is not effective. While soil bund can be done when there is no stone availability with medium slopes.

67.7% of respondents practiced biological treatments on bunds and terraces in their private farm lands. As per the respondents the main factor to use biological soil and water conservation structures are distances from home. Most of the time farmers practiced biological methods around their homes and backyards. *Vana grass, trilucern, vetch, sespanya* and pigeon pea are the most popular plants practiced in the study area.

Terracing plus water collection trench structures also one of the physical soil and water conservation structures in the study area especially for the steep slope and moderately sloppy

farmlands in the study areas. 57.4% of the respondents practiced hillside terraces with a one meter water collection trenches; 15-30 cm in front of the terrace. As my personal observation; these structures are more common in three sites those area Asenga, Serebar, and Gashajagre kebeles then the other two, Deresge and Denkolako kebeles.

Manure application on farm lands is one of a soil fertility management activities practiced in the study areas. 72.3% of the respondents were practiced manure applications in terms of compost and a mare animal's dung and urine mixture. Like the biological soil and water conservation activities, manure applications also practiced in a more nearby farm plots than the far plots or farm sites. Artificial fertilizers like DAP and urea fertilizers and bio-fertilizers are adopted in the study area.

4.2 Econometrics analysis result

4.2.1 Determinants of participating in SLM activities of farmers in their land

The binary logit model was estimated to find out the main determinants of farm households' decision to use SLM activities of farmers in their land presented in table 11.

Table 11 Marginal effects from logit estimation for determinants of participation in SLM activities

Variables	Marginal Effects	Std. Err	Z	P>z
AGEHH	-.0094158	.0030419	-3.10	0.002
HHsize	-.0005235	.0282048	-0.02	0.985
ADULTEQUI	-.0213285	.0264381	-0.81	0.420
HHEDUCA	-.0104346	.0179144	-0.58	0.560
MARHH	.0994793	.045695	2.18	0.029
SAVCRE	.0659322	.0480729	1.37	0.170
LANDSIZE	.1838398	.0890291	2.06	0.039
TLU	.0836099	.0262333	3.19	0.001
FRQEXT	.0189251	.0309877	0.61	0.541
DSTMRKT	.0077441	.006508	1.19	0.234
PLMAP	.0471847	.0404929	1.17	0.244

DSFLD	-.0366448	.0110024	-3.33	0.001
WUA	.1606536	.0418122	3.84	0.000

sources: own survey 2018

Link test was done to determine the association among the independent variable (Pregibon, 1979; Tukey, 1949). The values of the link test; in the logit regression model looks every bit as reasonable as the original model. The link test reveals no problems with our specification having seen a dataset, as shown in the (appendix 1 and 2). More over the result of the link test p value of hat square (.317) is statically insignificant means there is no enough evidence to say that the model is miss specified. Therefore, the participation decision model can be explained through the included explanatory variables. Additionally, the Pseudo R-square indicates that about 55.75 of the variation in the participation decision model can be explained through the included explanatory variables. The overall model is statistically significant at a P-value of 0.000. Hence, the chosen observable characteristics adequately explain the probability of participation (Table 11).

The output of the binary logit model showed that six variables were identified as significant variable out of the thirteen hypothesized variables that affect the household participation decision in the land resource management in the study area. These are age of the household (AGEHH), marital status of the household (HHEDUCA), total live stalk unit of the household (TLU), land size, distance of resident from land (DSFLD), membership of watershed user association (WUA) (Table 11).

Age of the household: The sign of this variable is consistent with the prior expectation that means negatively and significantly influenced the probability of household heads to participate in SLM activities at 1 % significance level. This may be because the participating in SLM is labor intensive and exhaustive work that the older household heads cannot tolerate this challenge. In another way the negative sign indicates that younger farmers more participated in SLM activities than the older farmers. (Phoeb et al., 2000) also found that the older the household head the less inclined to adopt new technology. The marginal effect also confirms that age of the household head increases by 1 year to certain level, the probability of participation in SLM activities would decreased by 0.9%, other variables in the model remaining constant.

Distance from residents' home to the farm land: The model result shows that distance from resident's home to the farm land significantly affected household's participation decision at 5% significance level. As the distance far from the homestead of households, incur transportation cost and labor intensive. The households might choose to practice soil and water conservation and some other land management activities in nearby farmlands to their home. The marginal value of this variable suggests that for one kilometer distance from farmland a household resides the possibility of partaking in land resource management decreases by 3.6%. Therefore, households that are far apart from the farmland discourage to participate in SLM activities. This result is in line with other studies conducted by (De Haan, 2012; Fekadu Abdissa *et al;*2017; Sikhulumile *et al*;2014; 50 Woldegebrial Zeweld *et al*; 2017).

Marital status of the house hold: The model result shows that marital status of the house hold that is whether the household head is married or single significantly affected household's participation decision at 5% significance level. As the household head is married, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if a house hold head is married the possibility of partaking in land resource management increases by 9.9%. Therefore, households with a married head would encourage participating in SLM activities. This result is in line with other studies conducted by Meshesha et al (2018) of in his study getting the household head married is advantageous to share information among members about the SWCP and who found the majority of the respondents participated in SWCP measures.

Total live stalk unit: The model result shows that the households' ownership of TLU significantly affected household's participation decision at 1% significance level. As the household head had more TLU, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if households had 1 more TLU the possibility of partaking in land resource management increases by 8.3%. This result is in line with other studies conducted by (W. Bekele etal 2003)Livestock is generally considered to be an asset that could be used either in the production process or be exchanged for cash or other productive assets. It is hypothesized that livestock holding of a household will affect the conservation decision positively. First of all livestock is considered as a measure of wealth and increased availability of capital which make investment in conservation more feasible

(Norris and Batie, 1987 cited in W.Bekele etal 2003). Secondly livestock, particularly oxen, are used as working assets to perform farm operations, including conservation, which increases the possibility for timeliness effects.

Land size: The model result shows that the households' ownership of more hectare of farm land significantly affected household's participation decision at 5% significance level. As the household head had more farm land, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if households had additional 1 hectare of his farm land the possibility of practicing in land resource management increases by 18.3%. This result is in line with other studies conducted by (W.Bekele etal, 2003). The size of a given plot is expected to influence the conservation decision positively. This is because conservation structures will take proportionally more space on small plots and the benefit from conservation on such plots will not be enough to compensate for the decline in production due to the loss in area devoted to conservation structures.

Membership of watershed users association: The model result shows that the households' membership of watershed users association significantly affected household's participation decision at 1% significance level. As the household head had being membership of watershed users association, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if households had participated and member of watershed users association; the possibility of practicing in land resource management increases by 16.06%.

4.2.2 Impacts of SLM activities on rural house hold income

Different soil water conservation practices implemented like bunds stabilized with grasses such as vetiver and other grasses brought changes on the nature of landscape. (Demelash et al 2010 as cited in Meshesha etal 2018)

The principal objective of this study is to show if there is any considerable impact of sustainable land resource management activities on household's livelihood or income. To this end, an effort was made to examine whether the land resource management participants had been aware of the changes in their mode of life or not. Income was livelihood indicators of the study; estimated using the selection equation as bases of separation across the two groups of households (participants and non-participants) and the estimation was carried out by using ESR model with full information maximum likelihood (FIML) procedure presented in (Table

12). As expected**,** the model diagnostics are satisfactory. Wald chi2 (12) indicates the overall fitness of the model at less than 1% significance level for outcome variables.

Table 12 Endogenous switching regression model parameter estimates

Variables	Income		Effects on participation
	Participant	Non participant	
AGEHH	0.0004	0.0021	-0.0534***
	(0.0041)	(0.0053)	(0.0182)
HHsize	0.0219	0.0821	0.0071
	(0.0376)	(0.0586)	(0.1680)
ADULTEQUI	0.0406	0.0941	-0.1563
	(0.0365)	(0.0586)	(0.1555)
HHEDUCA	-0.1355***	-0.0308	-0.0740
	(0.0350)	(0.0271)	(0.1133)
MARHH	0.0343	-0.1701**	0.6186**
	(0.0843)	(0.0737)	(0.2727)
SAVCRE	0.1535*	0.1207	0.4314
	(0.0834)	(0.0836)	(0.2917)
LANDSIZE	0.5841***	0.8358***	1.0674**
	(0.1111)	(0.1561)	(0.5173)
TLU	0.0917***	-0.0294	0.4593***
	(0.0320)	(0.0606)	(0.1574)
FRQEXT	0.1563***	-0.0879*	0.0952
	(0.0470)	(0.0492)	(0.1796)
DSTMRKT	0.0081	-0.0319***	0.0358
	(0.0098)	(0.0107)	(0.0404)
PLMAP	0.0644	-0.1125	0.2239
	(0.0515)	(0.0973)	(0.2482)
DSFLD			-0.2310***
			(0.0633)
WUA			1.0542***
			(0.2644)
Constant	10.7575***	9.9288***	0.0835
	(0.2561)	(0.2761)	(0.9808)
Observations	322	322	322
σ	.26	.38	
ρ	-.47	-37	
LR test of indep. eqns. :			ESR
chi2(1) 5.11* **	chi2(12) 2.88*		
Wald chi2(11) 410.34***	Wald chi2(12) 1648***		
Log likelihood -170.90	Number of obs 322		

Source: own survey 2018

The likelihood ratio test of independence equations for income conditional on the selection equation test reported in (Table 12), rejects, the hypothesis that the three equations are jointly independent.

The correlation coefficients were significant at 1% significance level income. Moreover, this result suggests that the three equations were jointly dependent, providing evidence of Endogenity that needs to be controlled in the model specification of income equations. Moreover, the estimated coefficient of correlation between the selection equation and the household income (ρ1Y) of SLM participants were negative and statically significance at 1% and 5% respectively, indicating a failure to reject the hypothesis of sample selection bias (Table 12).This confirms the presence of selection bias suggesting that addressing the self-selection bias issue by accounting for both observable and unobservable factors are a prerequisite for obtaining consistent and unbiased treatment effect of sustainable land resource management activities participation.

The negative and significance of $\rho_1 Y$ indicates negative selection bias, suggests that farm households that choose to participate in sustainable land resource management activities obtain higher income due to unobserved characteristics than a random farm household in that regime. The correlation coefficient sustainable land resource management activities participation and non-participants' income ($\rho_2 Y$) were negative but not significantly different from zero. It indicates that, without participating sustainable land resource management activities, there would be no significant difference in average behavior of the two farm household groups which arises from unobserved effects.

The estimated results presented in (Table 12), also demonstrate that, a significant variation on the impacts has been revealed across the two groups of households. These variations were accounted for sustainable land resource management activities participants' statuses of households, keeping other things remain constant. This implies that the condition to participate in sustainable land resource management activities distorted the effect of explanatory variables across the two groups of households. Accordingly, endogenous switching regression model estimates, significant determinant variables of livelihood outcomes that is income, from the estimated result were age of the household head, education level of household head, marital status of the household, participating in saving and credit institutions, land size, tropical lives talk unit, frequency of extension, Distance from residents' to local market, distance of farm land from the households home, and membership of households to watershed users association.

Age of the household head: In the switching regression estimates, the coefficient of age was negative and significant for effects on income and the negative sign showed that older farmers were found to be relatively less active in use of technology. However, the relationship between age square of the household and participation is not linear but inverted U-shaped, suggesting that beyond a certain age users and non- users increased their income. This implies that although increasing age increases the likelihood of participation in SLM activities, it reduces it at a certain stage. This result is similar to the findings of (Awudu & Wallace, 2014; Kidanemariam G. Gebrehiwot et al., 2017; Owusu et al., 2011).

Household head education status: It was significantly and negatively affected participants to use SLM technologies at 1% significance level. The higher households head education level decrease the level of participation and affected negatively the households' income.

This result is consistent with Awudu & Wallace (2014) found that households with more labor endowment more likely to adopt new technologies.

Marital statuses of the house hold was negatively affected the non-participants income at 5% significance level. Single House hold heads were less income than married non participant household heads. It has been posited that marriage brings an array of benefits (Waite and Gallagher, 2000): in economic terms, since marriage generally adds a potential earner to the household, it seems obvious that marriage should increase the economic well-being of members of the family, including the children. Married women living in male-headed households have the prospect of enjoying larger family income because these families have a larger number of earning members and especially a larger number of earning male members. A long-term marital relationship may also mean higher permanent income and a larger build-up of consumer durables, factors that could limit the extent of economic hardship experienced in down turns in the economy. In addition, married couples may be more easily able to draw on relatives for help in difficult situations; Indeed, as Grinstein-Weiss and Sherraden 2006 cited in John C. Anyanwu 2014 note, marriage has a number of important features that enhance wealth accumulation (Lupton and Smith, 2003; Schoeni, 1995; Waite, 1995; Waite and Gallagher, 2000; Wilmoth and Koso, 2002 as cited in John C. Anyanwu 2014).One feature is that since marriage involves long-term commitment, it increases the

productivity and the efficiency of the household through couples' specialization in specific skills and duties.

Access to participation to saving and credit affected participants' income 15.35% citrus paribus positively and significantly at 10 % significance level. The positive sign indicates that household which use credit does initiate investment in farm and non-farm activities for their livelihood improvement. This result is in line with (Bekele and L.drake 2003) that the credit for household food and small financial requirements are expected to positively influence conservation decision. It is also in line with the findings of Rutherford, S. 2000 which confirms; Participation in Micro finance institutions creates on-farm and nonfarm employment opportunities, increases consumption expenditure and accumulating assets.

Cultivated land size was positively and significantly affected both participants and non-participants income at 1% significance level. Households have cultivated land produce relatively sufficient amount of crop by their own or through different contractual agreements such as share cropping. This result is similar with (W.Bekele 2003) which illustrates that the landholding per economically active person of the family is found to have a very significant (PB/0.01) and significant (PB/0.05) negative correlation with modified and recommended type of conservation structures respectively; and showed a significant (PB/0.05) negative correlation with traditional conservation decisions. It indicates the preference of farmers with larger landholding per economically active person of the family to invest less or not to invest at all in conservation.

Livestock holding was positively and significantly affected the participants' income at 1% significance level. The households with more livestock produce livestock products for direct consumption of their family. Besides, holding more livestock enables the farm households to have better chance to earn more income from the sale of the livestock. As illustrated by the study conducted by Fitsum and Holden, 2003; Hilina, 2005; Kefelegn, 2007; Dereje, 2008 as cited in Abbubekir 2010; livestock are the source of livelihood of pastoralist and agro-pastoralist community. Possession of livestock is expected to have a positive impact on households‟ poverty situation. Since livestock are used as source of food (milk, milk product and meat for direct consumption), live asset/bank, source of cash income, means of purchasing power, social security, means of copping. Therefore, it is expected that a higher number of TLU will increase the probability of the household to be non-poor. That is, as TLU increases the likelihood to be poor reduces.

Extension contact was positive and significance for SLM activities participants` income. Provision of extension service to farmers play important role in terms of creating knowledge and skills in different income generation activities; such as off farm and non-farm activities; and technologies adoption. Awudu & Wallace (2014) argued that positive and statically significant indicating that farmers with extension contact likely to adopt new technology.

Distance from residents' to nearly local market was negative and significance for SLM activities participants` income at 1% significance level. The negative sign indicates that households far from local market incur high marketing and transportation cost while producing and marketing farm products inconvenience of in transporting perishable and other non-perishable products. The households might choose to sell their product with cheaper price to neighbor traders. Access to market may create opportunities to get information about input and output price, market demand, and also drive agro-pastoralists to be engaged in non-farm employment to generate income. Hypothetically, there is direct relationship between market

Distance from residents' to the farm land was negative and significance for SLM activities participants` income at 1% significance level. The negative sign indicates that households far from the farm land incur high transportation cost and time consuming while households labor utilization. The households might choose to participate in SLM activities in near and around residents' farm lands. The same result was found by (W.Bekele 2003) according to bekele`s finding studied in eastern highlands of Ethiopia distance from the farm dwelling is influence conservation decision negatively for two reasons. The closer the plot is to the farm dwelling area the closer supervision and attention it will get from the family. The other argument is derived from land tenure policy in Ethiopia. Land in Ethiopia is the property of the state and farmers only have the right to use the land. Any form of exchange of land is prohibited and land redistributions by the regional states and local authorities are frequent. In cases where a family has more land than the average of the village, the family may fear loss of plots to land redistribution. Under these circumstances, the plots that are most distant are those most subject to fear of loss. Length or duration of use of a plot is expected to influence conservation decision positively because a longer period of control will give the farmer a sense of tenure security and as a result, encourage him to have longer planning horizon. In

addition, a longer period of use will give the farmer the chance to observe and recognize the yield reducing effects of soil erosion, i.e. learn from experience.

The other research conducted by Emily Schmidt and Fanaye Tadesse 2012; remoteness of the farm land has a significant but small negative correlation with household probability of adopting sustainable land and water management.

Households' membership in watershed users association; it is an instrumental variable; positively and significance for SLM activities (see appendix 3 and 5) participation of participants of SLM activities at 1% significance level. It affects the dependent variable adoption decision but not the outcome variable; income. The positive sign indicates that households which are members to watershed users association are more likely to adopt and practice SLM activities due to knowledge, skill and new information sharing among members and since they are abide by the associations bylaw to participate in watershed management activities in both private and communal lands. The watershed users association is a legal association, registered and had legal basis based on the ANRS watershed users association establishment proclamation number 204/2005.

Table 13 Test of predicted outcomes with endogenous switching regression model

Outcome	Household type	Decision stage		Treatment effect
Variable	and treatment effects	Participants	Non-participants	
Income (Y)	SLM participants	(a) 149499.9	(c) 118235.9	ATT_y = 31264**
	Non-participants	(d) 110555	(b)69034.18	ATU_y= 41520***
	Het effects	BH_{1y}= 38944.9	BH_{2y}= 49201.72	TH_y = -10256

*, ** and *** represent significance at 0.1, 0.05 and 0.01 levels respectively. Source: own survey calculation (2018)

An important question is whether farmers that practice or participated in SLM activities in their own land improve their livelihood status in terms of income. The results, obtained using equations (5 up to 13), are presented in (Table 13). In other words, to evaluate the impacts of SLM activities on farmers' income; the conditional expected income by the participants E (Y_{1i} = 1) are compared with what they would have enjoyed the non-participants E (Y_{2i}= 0). As shown from (Table 13), the observed difference in income between the participants and non-

participants (ATE) were ETB 80465.72 (a) – (b). However, this simple comparison is misleading because unobserved factors that may impacted of both outcome variables was not accounted.

Hence, following Carter & Milon (2005), the base heterogeneity due to the potential unobservable effect on the livelihood outcome variables was included to get the true impact estimate. BH (referred as base heterogeneity). Within the counterfactual condition, that SLM participants placed in the non-participants status (BH_{1Y}) in (Table 13) households would be expected to earn , an average of, ETB 38944.9 less income, the counterfactual condition that the non-participants placed in the participants status (BH_{2Y}), would expected to earn , an average of, ETB 49201.72earn more income.

Therefore, from the outcomes (income) counterfactual conditions, the non-participants under the status of participating in SLM activities would have performed better than the participants. This results participating effects is larger for the counterfactual non-participants households and less for participants, resulting in a negative transitional heterogeneity effect of outcome variable TH_Y (ETB -10256 less income). This negative sign implies the initial outcome variable income of non-participants were higher than the participants before five years of the beginning of the intervention SLM program; so if non participants practiced SLM activities they will have more income than the merely participants and vice versa citrus paribus.

The survey result revealed that, the actual expected income of the participants E (Y_{1i} |S = 1) was approximately ETB 149499.9, while the expected income that of non- participants would have enjoyed if they did participate in SLM activities (counterfactual of the SLM participants) E (Y_2 |S = 1) was approximately ETB 118235.9. Therefore, the observed income gap (ATT) was found to be ETB 31264 due to SLM activities. Similarly, the counterfactual of the non-participants (if non- participants decided to participate in SLM) (ATU) was ETB 41520 higher income than their counterpart. Both results were statically significant at less than 1% significance level. The results are in agreement with other studies that reports positive link between SLM participation and income (Kidanemariam G. Gebrehiwot et al., 2017; Woldegebrial Zeweld et al., 2015). It is also the same to (Owusu et al., 2011), the study conducted in northern Ghana.

5. Conclusions and Recommendations

5.1 Conclusions

This study analyzes the impact of SLM activities on farmers' or households income in Janamora *Wereda*, Northern Ethiopia. The study revealed that, the income of the participants was found to be better than that of non-participants of SLM Practices.

Through applying Logit and ESR model the study identified six variables are significant out of the thirteen hypothesized variables that affect the household participation decision in the land resource management in the study area. These are age of the household, marital status of the household, total live stalk unit of the household, land size, distance of resident from land, membership of watershed user association.

Age of the household is consistent with the prior expectation that means negatively and significantly influenced the probability of household heads to participate in SLM activities at 1 % significance level. This may be because participating in SLM is labor intensive and exhaustive work that the older household heads cannot tolerate this challenge.

Distance from resident's home to the farm land significantly affected household's participation decision at 5% significance level. As the distance far from the homestead of households, incur transportation cost and labor intensive. The households might choose to practice soil and water conservation and some other land management activities in nearby farmlands to their home. The marginal value of this variable suggests that for one kilometer distance from farmland a household resides the possibility of partaking in land resource management decreases by 3.6%.

Marital status of the house hold of the house hold that is whether the household head is married or single significantly affected household's participation decision at 5% significance level. As the household head is married, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if a house hold head is married the possibility of partaking in land resource management increases by 9.9%.

Households' ownership of TLU significantly affected household's participation decision at 1% significance level. As the household head had more TLU, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if households

had 1 more TLU the possibility of partaking in land resource management increases by 8.3%. Households' ownership of more hectare of farm land significantly affected household's participation decision at 5% significance level. As the household head had more farm land, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if households had additional 1 hectare of his farm land the possibility of practicing in land resource management increases by 18.3%.

Households' membership of watershed users association significantly affected household's participation decision at 1% significance level. As the household head had being membership of watershed users association, there is a possibility of participating in SLM activities. The marginal value of this variable suggests that if households had participated and member of watershed users association.

The results of the endogenous switching regression model revealed that the conditional expected incomes by the participants are compared with that of non-participants; the observed difference in income between the participants and non-participants or an average treatment effect were ETB 41520. However, this simple comparison is misleading because an unobserved factor that may impact both outcome variables was not accounted for. So to avoid these misleading the base heterogeneity due to the potential unobservable effect on the livelihood outcome variables was included to get the true impact estimate. Within the counterfactual condition, that SLM participants placed in the non-participants status households would be expected to earn, an average of, ETB 38944.9less income, the counterfactual condition that the non-participants placed in the participants status, would expected to earn , an average of, ETB 49201.72earn more income.

Therefore, from the outcomes variable (income) counterfactual conditions, the non-participants under the status of participating in SLM activities were performing better than the participants. This results participating effects is larger for the counterfactual non-participants households and less for participants, resulting in a negative transitional heterogeneity effect of outcome variable TH_Y (ETB 88146.603less income) which means if non participants were to be participants they may have better income than the current participant HHs, so in general participating in SLM activities in the study area had positive and productive impact on the study area.

The survey result revealed that, the actual expected income of the participants was approximately ETB 110555, while the expected income that the non-participants of SLM activities would have enjoyed if they participate (counterfactual of the SLM activities participants) was approximately ETB 118235.9. Therefore, the observed income gap (ATT) was found to be ETB -7680.873 (which the non-participants miss) due to non-participating in SLM activities. Similarly, the counterfactual of the non-participants (if non- participants decided to participate in SLM) or if participants are participated at the place of non-participants position of before five years (ATU) was ETB 80465.73 higher income than their counterpart. Both results were statistically significant at less than 1% significance level.

5.2. Recommendations

The results indicate that land resource management activities have a profound effect on household income improvement. Hence, such activities need to be encouraged and scaled up to other areas and involve more households. Based on the findings, this study suggests the following general recommendations.

- Since participating in SLM is labor intensive and exhaustive work that the older household heads cannot tolerate this challenge; so government intervention should focused on older household heads farm land and motivating younger households by different mechanisms.
- Distance from resident's home to the farm land affected household's participation decision. As the distance far from the homestead of households, incur transportation cost and labor intensive. So government and non-government organizations should work on transportation access to the rural farm land.
- Marital status of the house hold of the house hold that is whether the household head is married or single significantly affected household's participation decision. As the household head is married, there is a possibility of participating in SLM activities. So promoting social values and cultures of marriage and protecting marriage is useful to have stable households and more work forces to SLM activities.
- Households' ownership of TLU significantly affected household's participation decision. As the household head had more TLU, there is a possibility of participating in SLM activities. So government intervention in these regards; enabling farmers to

have live stalk based on the agro-ecological variability and farmers experiences as well as accessing animal health facilities.

- Households' ownership of more hectare of farm land significantly affected household's participation decision. As the household head had more farm land, there is a possibility of participating in SLM activities. Working on land tenure security and ways of having additional farm land of the household through different farm land transferring systems is essential because if the farmers have less farm land, there is a need for alternative livelihood strategies other than farming and less attention to devote on land resource management activities.
- Households' membership of watershed users association significantly affected household's participation decision. As the household head had being membership of watershed users association, there is a possibility of participating in SLM activities. The agricultural sectors started farmers to be a member of watershed users association and it had legal grounds in Amhara region, but the implication of those legal instruments had still in question, so promoting these activity and members to be members WUA would positively influence farmers' decision to participate in their land management activities.
- Finally participating in SLM activities had positive impacts on households' income; but as per this research paper the counterfactual non participants would have to more income than themselves if they had been participated; so the government intervention should have inclusive policy to the marginalized and less extension contacted farmers to avail all farmers livelihood in a better manner.

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Appendix

Appendix 1.Logit Estimation for Participation in sustainable land resource management

Logit PARTCPNT AGEHH HHsize ADULTEQUI HHEDUCAMARHH SAVCRE LANDSIZE TLU FRQEXT DSTMRKT PLMAP DSFLD WUA

Iteration 0: log likelihood = -223.19339

Iteration 1: log likelihood = -103.28557

Iteration 2: log likelihood = -99.334019

Iteration 3: log likelihood = -99.258977

Iteration 4: log likelihood = -99.258946

Iteration 5: log likelihood = -99.258946

Logistic regression Number of obs = 322

LR chi2 (13) = 247.87

Prob > chi2 = 0.0000

Log likelihood = -99.258946 Pseudo R2 = 0.5553

PARTCPNT	**Coef.**	**Std. Err.**	**z**	**P>z**	**[95% Conf. Interval]**	
AGEHH	-.1026812	.0337946	-3.04	0.002	-.1689174	-.0364449
HHsize	-.0057087	.3075757	-0.02	0.985	-.6085461	.5971287
ADULTEQUI	-.2325918	.2884723	-0.81	0.420	-.797987	.3328035
HHEDUCA	-.113791	.1956861	-0.58	0.561	-.4973287	.2697467
MARHH	1.084842	.5030638	2.16	0.031	.0988553	2.070829
SAVCRE	.7190039	.5309484	1.35	0.176	-.3216358	1.759644
LANDSIZE	2.004811	.9793103	2.05	0.041	.0853981	3.924224
TLU	.9117829	.2946135	3.09	0.002	.3343511	1.489215
FRQEXT	.2063824	.3380874	0.61	0.542	-.4562567	.8690215
DSTMRKT	.0844513	.0713772	1.18	0.237	-.0554454	.2243479
PLMAP	.5145595	.4439725	1.16	0.246	-.3556107	1.38473
DSFLD	-.3996192	.1250286	-3.20	0.001	-.6446706	-.1545677
WUA	1.751961	.4831364	3.63	0.000	.8050314	2.698891
_cons	.0116703	1.80219	0.01	0.995	-3.520557	3.543898

Appendix 2

Link test

Iteration 0: log likelihood = -223.19339

Iteration 1: log likelihood = -99.641856

Iteration 2: log likelihood = -98.800434

Iteration 3: log likelihood = -98.753759

Iteration 4: log likelihood = -98.753648

Iteration 5: log likelihood = -98.753648

Logistic regression Number of obs = 322

LR chi2 (2) = 248.88

Prob > chi2 = 0.0000

Log likelihood = -98.753648 Pseudo R2 = 0.5575

PARTCPNT	Coef.	Std. Err.	Z	P>z	[95% Conf.
_hat	1.012784	.1017109	9.96	0.000	.8134348
_hatsq	-.0493145	.0493155	-1.00	0.317	-.145971
_cons	.1720349	.2518131	0.68	0.494	-.3215097

Appendix 3.Instrumental variables (2SLS) regression test

Ivregress 2sls logY AGEHH HHsize ADULTEQUI HHEDUC MARHH SAVCRE LANDSIZE TLU FRQEXT DSTMRKT PLMAP (PARTCPNT=DSFLD WUA)

Instrumental variables (2SLS) regression Number of obs = 322

Wald chi2 (12) = 1648.49

Prob > chi2 = 0.0000

R-squared = 0.8247

Root MSE = .34699

Robust

LogY Coef. Std. Err. z P>z [95% Conf. Interval]

PARTCPNT .2213948 .1558754 1.42 0.156 -.0841155 .526905

AGEHH .0007435 .0031164 0.24 0.811 -.0053646 .0068517

K2HHsize .0873145 .0297936 2.93 0.003 .0289202 .1457089

ADULTEQUI .0615903 .0319156 1.93 0.054 -.0009631 .1241437

HHEDUCA -.0621027 .0212055 -2.93 0.003 -.1036648 -.0205407

MARHH -.1783497 .0671086 -2.66 0.008 -.3098801 -.0468193

SAVCRE .0520292 .0776271 0.67 0.503 -.1001172 .2041756

LANDSIZE .755627 .0921358 8.20 0.000 .5750442 .9362098

TLU .0102629 .0341098 0.30 0.764 -.0565911 .0771169

FRQEXT -.1107806 .0421046 -2.63 0.009 -.1933042 -.028257

DSTMRKT -.0214751 .0086972 -2.47 0.014 -.0385212 -.0044289

PLMAP .0182031 .0555392 0.33 0.743 -.0906518 .127058

_cons 10.21661 .2053567 49.75 0.000 9.814119 10.6191

Instrumented: PARTCPNT

Instruments: AGEHH HHsize ADULTEQUI HHEDUCA MARHH SAVCRE LANDSIZE TLU FRQEXT DSTMRKT PLMAP DSFLD WUA

Appendix 4.Tests of Endogenity

Tests of Endogenity

Ho: variables are exogenous

Durbin (score) chi2 (1) = 3.30323 (p = 0.0691)

Wu-Hausman F (1,308) = 3.19236 (p = 0.0750)

Robust score chi2 (1) = 3.3186 (p = 0.0685)

Robust regression F (1,308) = 3.2352 (p = 0.0731)

Appendix 5.Instrumental Variable Test

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(2,308)	Prob > F
PARTCPNT	0.6136	0.5973	0.1349	20.4481	0.0000

Minimum eigenvalue statistic = 24.0047

Critical Values # of endogenous regressors: 1

Ho: Instruments are weak # of excluded instruments: 2

2SLS relative bias	5%	10%	20%	25%
			(Not available)	

	5%	10%	20%	25%
2SLS Size of nominal 5% Wald test	19.93	11.59	8.75	7.25
LIML Size of nominal 5% Wald test	8.68	5.33	4.42	3.92

K2

Appendix 6 Tests of over identifying restrictions:

Sargan chi2 (1) = .143175 (p = 0.7051)

Basmann chi2 (1) = .137011 (p = 0.7113)

Score chi2 (1) = .14199 (p = 0.7063)

Appendix 7.Endogenous switching regression model parameter estimates for income

Movestay (logY AGEHH HHsize ADULTEQUI HHEDUCA MARHH SAVCRE LANDSIZE TLU FRQEXT DSTMRKT PLMAP), select (PARTCPNT AGEHH HHsize ADULTEQUI HHEDUCA MARHH SAVCRE LANDSIZE TLU FRQEXT DSTMRKT PLMAP DSFLD WUA)

Fitting initial values.....

Iteration 0: log likelihood = -174.00698

Iteration 1: log likelihood = -171.13281

Iteration 2: log likelihood = -170.90706

Iteration 3: log likelihood = -170.90645

Iteration 4: log likelihood = -170.90645

Endogenous switching regression model Number of obs = 322

Wald chi2 (11) = 410.34

Log likelihood = -170.90645 Prob > chi2 = 0.0000

	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
logY_1						
AGEHH	.0003621	.0040584	0.09	0.929	-.0075923	.0083165
HHsize	.0218846	.0375749	0.58	0.560	-.0517609	.0955301
ADULTEQUI	.0406273	.0365013	1.11	0.266	-.0309139	.1121686
HHEDUCA	-.1355021	.0349932	-3.87	0.000	-.2040875	-.0669167
MARHH	.0343373	.0843322	0.41	0.684	-.1309507	.1996254
SAVCRE	.1534787	.0833844	1.84	0.066	-.0099518	.3169092
LANDSIZE	.584123	.1111035	5.26	0.000	.3663641	.801882
TLU	.0916623	.0319568	2.87	0.004	.0290281	.1542964
FRQEXT	-.1563216	.0469984	-3.33	0.001	-.2484367	-.0642064
DSTMRKT	.0080992	.0098022	0.83	0.409	-.0111128	.0273112
PLMAP	.0643679	.0514536	1.25	0.211	-.0364794	.1652152
_cons	10.75751	.2560956	42.01	0.000	10.25557	11.25945
logY_0						

AGEHH	.0021178	.0052988	0.40	0.689	-.008267	.0125032
HHsize	.082084	.0586404	1.40	0.162	-.032849	.1970169
ADULTEQUI	.0940813	.0586223	1.60	0.109	-.0208163	.2089789
HHEDUCA	-.0308174	.0271265	-1.14	0.256	-.0839844	.0223496
MARHH	-.1701424	.0737053	-2.31	0.021	-.3146021	-.0256828
SAVCRE	.120675	.0835857	1.44	0.149	-.04315	.2844999
LANDSIZE	.8358084	.1560777	5.36	0.000	.5299018	1.141715
TLU	-.0293534	.0606189	-0.48	0.628	-.1481642	.0894574
FRQEXT	-.0878922	.0492015	-1.79	0.074	-.1843254	.0085409
DSTMRKT	-.0319441	.0107038	-2.98	0.003	-.0529231	-.0109651
PLMAP	-.1124702	.0973302	-1.16	0.248	-.3032339	.0782934
_cons	9.92879	.2761453	35.95	0.000	9.387555	10.47002

PARTCPNT

AGEHH -.0534052 .0182172 -2.93 0.003 -.0891102 -.0177002

HHsize .0071477 .1679747 0.04 0.966 -.3220766 .336372

ADULTEQUI -.1563397 .1554867 -1.01 0.315 -.4610882 .1484087

HHEDUCA -.0740049 .1133378 -0.65 0.514 -.2961429 .1481331

MARHH .6185764 .2726884 2.27 0.023 .0841168 1.153036

SAVCRE .4313942 .2917123 1.48 0.139 -.1403515 1.00314

LANDSIZE 1.067421 .517346 2.06 0.039 .0534413 2.0814

TLU .4592976 .1574166 2.92 0.004 .1507667 .7678286

FRQEXT .0952212 .1796472 0.53 0.596 -.2568808 .4473231

DSTMRKT .0358144 .0403515 0.89 0.375 -.043273 .1149019

PLMAP .2239303 .2481616 0.90 0.367 -.2624575 .7103181

DSFLD -.230996 .0632794 -3.65 0.000 -.3550214 -.1069706

WUA 1.054179 .2643689 3.99 0.000 .5360259 1.572333

_cons .0834544 .9807714 0.09 0.932 -1.838822 2.005731

/lns1 -1.354764 .064588 -20.98 0.000 -1.481355 -1.228174

/lns2 -.9740148 .0624078 -15.61 0.000 -1.096332 -.8516977

/r1 -.5157612 .2595187 -1.99 0.047 -1.024409 -.0071139

/r2 -.3899349 .2952487 -1.32 0.187 -.9686116 .1887419

sigma_1 .2580081 .0166642 .2273295 .2928267

sigma_2 .3775641 .023563 .3340943 .4266899

rho_1 -.4744219 .2011073 -.7716561 -.0071137

rho_2 -.3713041 .2545437 -.7480935 .1865321

LR test of indep. eqns. : chi2(1) = 5.11 Prob > chi2 = 0.0238

Appendix 8.Average treatment on treated (ATT) /user for income

Two-sample t test with equal variances (test yc11 =yc01, unpaired)

Variable	Obs	Mean	Std. errs.	Std.dev	[95% Conf. Interval]	
yc11	145	149499.9	7401.64	89127.64	106620.9	114489.1
yc01	177	118235.9	2786.634	37073.76	112736.4	123735.4
combined	322	132314.4	3763.105	67526.57	124910.9	139717.9
Diff		31264	7371.103		16762.1	45766
diff = mean(yc11) - mean(yc01)					t = 4.2414	
Ho: diff = 0				degrees of freedom = 320		
Ha: diff < 0 Ha: diff != 0				Ha: diff > 0		
Pr(T < t) = 0.0160 Pr(T > t) = 1.000				Pr(T > t) = 0.0000		

Appendix 9.Average treatment effect on untreated (ATU) (non-participant) income

Two-sample t -test with equal variances (ttest yc10=yc00, unpaired)

Variable	Obs	Mean	Std. err.	Std.dev	[95% Conf. Interval]
yc10	145	110555	1990.36	23967	106620.1
yc00	177	69034.18	4285.914	57020.33	60575.79
Combined	322	87731.44	2768.73	49683.09	96126.06
Diff		41520.81	5067.413		31551.16
diff = mean(yc10) - mean(yc00)					t = 8.1937
Ho: diff = 0				degrees of freedom = 320	
Ha: diff < 0	Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 1.0000	Pr(T > t) = 0.0000			Pr(T > t) = 0.0000	

Appendix 10.Conversion factors used to compute adult equivalent

Labor class	Age (years)	Conversion factor Mean
Children	<7	0
Children	7-14	0.4
Adult male	15-64	1.0
Adult female	15-65	0.8
Old male	greater than 65	0.5
Old female	greater than 65	0.5

Source: (Storck et al., 1991)

Appendix 11.Conversion factors used to compute tropical livestock units (TLU)

Livestock Category	Conversion factor
Calf	0.25
Weaned calf	0.34
Oxen / Cow	1.00
Bull	0.75
Heifer	0.75
Horse /mules	1.10

Donkey adult	0.70
Donkey young	0.35
Goats /sheep adult	0.13
Goat /Sheep young	0.06
Poultry birds	0.013

Source: (Storck et al., 1991)

Appendix 12.Questionnaire

BAHIR DAR UNIVERSITY

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT OF AGRICULTURAL ECONOMICS

SURVEY QUESTIONNAIRE

- **Dear respondent**, the questionnaire is prepared to analyze **the impacts of sustainable** *land resource management on household income in Janamora woreda*. The study focuses on analyzing the impacts of sustainable land resource management on household incomes of Janamora Wereda;
- And it specifically aims.
  - to assess the status of sustainable land management practices in *Janamora wereda;*
  - to examine the determinants of participating in SLM activities of farmers in their land;
  - And finally to assess the impacts of soil and water conservation activities on rural house hold income in *Janamora wereda.*

Therefore, your active participation and genuine responses is very important in meeting the intended objectives of the study. Your responses would be confidential. I kindly request your active cooperation in responding to the questionnaires.

Thank you for your time and cooperation

SLRM participant Code (0=non-participants 1=participants) (to be filled by the researcher)

Survey area (Kebele) …… (1= Denkolako 2=Deresge 3=Asenga 4=Serebar 5=Gashajagre)

Name of Enumerator…… Date…….Signature……..

1. BASIC HOUSEHOLD INFORMATION /CHARACTERISTICS

1.1 Name of the household head_____

1.2 Age of the household head_____ years

1.3 Sex of household head_____ 1. Male 0. Female

1.4 Marital status 1. Single 2. Married 3. Divorced 4. Widowed

1.5 Household size _____including the head of the HH.

1.6 Household age and sex composition

Age Group	Gender		Total
	Male	Female	
Under 15years			
15-30 years			
> 30 <65 years			
Above 65 years			

1.7 How do you categorize your family labor for your agricultural land activities?

1= small 2= enough 3= large 4= excessive

1.8 What maximum level of education attained by the head of the HH?

1.9 Major job or occupation of the Household Head…

1=Farming 2=Weaving 3=petty Trading 4=carpentry 5=Black Smith 6=Daily Lab our 7= pottery 8= other/specify/----------

2. HOUSEHOLD EXPENDITURE

2.1 Food expenditure

Item	Own consumption in 2017/18		Consumed from purchase in 2017/18	
	Amount consumed (kg)	Total Value (Birr)	Total Amount (kg)	Total Value (Birr)

Cereals				
Teff				
Barley				
Wheat				
Maize				
Sorghum				
Peas				
Beans				
Fruit &vegetables				
Banana				
Onions				
Potatoes				
Cabbage				
Keisir				
Other				
Animal source				
Butter				
Milk				
Egg				
Meat				
Cheeses				

Spices				
Salt				
Oil				
Sugar				
Coffee				
Other				

2.2 How much does your household spend on average (using the year 2010 E.C.) for one month on food consumptions? Br. _____

2.3 Non-Food Expenditure

Number	Item	Expense /Qua*price/
1	**Expenses on Clothing**	
	Student Uniforms	
	Clothing for father/mother	
	Clothing for other family members (excluding uniforms)	
	Shoes	
	Bed sheets and Blankets	
	Other clothing items	
	Total	
2	House rent (if any)	
3	Water expense (if Any)	
4	Transport and communication	

5	Entertainment /visit of relatives	
6	**Expenditure on Education**	
	Exercise books and books	
	Pens and pencils	
	Tuition fee	
	Transport to and from school	
	Other expenses on education	
	Total	
7	Health care	
8	Religious and culture expense	
	Tsebel, Mahber	
	Eddir	
	Wedding	
	Teskar, sedeqa	
	Kristina	
	Others	
	Total	
9	Animal health expense	
10	Government tax	
11	Labor expense	
12	Input expense (add all input expanses)	
13	Construction expense	

14	Fire wood and Fuel /Cooking/lighting Gas, Match	
	Firewood	
	Animal Dung	
	Coal	
	Cooking/lighting Gas lamba	
	Match (kirbit)	
	Total	
15	**Cleaning, and Personal Care items**	
	Hair oil	
	Hair Butter Purchased	
	Hair Butter from own product	
	Soap for clothing and body	
	Total Expense	
16	**Household Items and Jewelry Purchases**	
	Chair, bench, duka, etc.	
	Table or similar items	
	Box, Cupboard, shelf…	
	Bed (metal or wooden)	
	Tape recorder/ Radio	
	Plastic buckets, cups, etc.	
	Glasses (for tea, drinks,)	
	Pot	

	Gold	
	Silver	
	Watch	
	Bicycle	
	Cart (‘gari’); wheelbarrow	
	Other household items	
	Total Expense	

2.4 Did you have some social organization (PA, Idir) in the community so far? 1=Yes 0=No

Organization		Non-participant (Tick 1)	member (Tick 2)	Committee member (Tick 3)	leader (Tick4)	Frequency of participation in activity		
						Never (1)	Sometimes (2)	Always (3)
1	Idir							
2	Iqub							
3	Religious club							
4	Watershed users association							
5	Marketing association							
6	Cooperative/union							
7	PA leader							
8	Saving and credit							

9	School council							

3. AGRICULTURAL PRODUCTION AND LAND MANAGEMENT DATA (plot level)

3.1 CROP PRODUCTION AND MANAGEMENT

3.1.1 Total land size _____ Timad (…..ha) number of plots

3.1.2 Characteristics of plots more than 0.25 ha in 2010 e.c

Plot code	Distance from home	Plot size	Level of fertility code A	How frequently you practiced in land management activities with the last 5 years either constructing or maintaining? Code B	Reason for not participated (if any) Code C	Variety of land management practiced (multiple answer is possible code D	Slope of the land Code E
1							
2							
3							
4							
5							
6							
			Code A 1=Fertile 2=moderately fertile 3= unfertile	Code B 1≥ all 5 years 2=four years 3=three years 4= two years 5= 1 year 6=not at all	Code c 1= no had knowledge 2= no awareness about it 3= having fertile land 4= shortage of technical	Code D 1= PSWC 2=BSWC 3= Soil fertilizers	Code E 1= Gentle 2= medium slope 3= steep slope

					tools 5= labor pbm 6= other		

3.1.3 Patterns of rain fall in the area 2010 e.c 1= enough 2= moderate 3= low

3.1.4 How was your agricultural production for the last five years?

1= excess for annual household consumption 2= sufficient for annual household consumption

3= sufficient for six months only 4= sufficient for less than six months

5= others (specify) _____

3.1.5 What type of crop do you grow in the land in rain-fed last year?

Plot code	Crop type Code A	Area in ha.	Production quintal in ha.	Total value in birr	Total Birr	
					Consumed	sold
1						
2						
3						
4						
5						
6						
	CODE A 1=Teff 2=wheat 3= barley 4= fava bean 5= field pea 6= lentil 7= sorghum 8= others					

3.1.6 How do you compare existing production with that of 5 years? (2010 for the plot 1)

1= Increased 2=Decreased 3=No change

3.1.7 If production has decreased what are the reasons? (2010 for the plot 1)

1= shortage of rain full 2=shortage of new technologies 3=pest and disease 4= shortage of land 5= shortage of improved input 6= shortage of labor 7= poor soil fertility 8 =specify----------**5.2 Livestock Production**

3.2 ANIMAL PRODUCTION AND MANAGEMENT 2010 E.C

3.2.1 Do you have livestock? 1. Yes 2. No

3.2. 2 if your answer for Question no.5.2.1 is yes, livestock Number:

1. Ploughing Oxen/bulls _____ 6. Goats_____

2. Cows/heifers_____ 7. Sheep_____

3. Calves _____ 8. Donkeys_____

4. Horses _____ 9. Mule _____

5. Chickens _____ 10. Others

3.2.3 Income from the sale of livestock and livestock product 2010

Type of Animal	No of animals	Total Owned	How much if you want to Sell (Nov-June 2017/18)	If there is any animal Sold	
				Sold Amount	Income gained (Birr)
Cow					
Bull					
Heifer					
Calf					
Ox					

Mules					
Horse					
Donkey					
Goat					
Sheep					
Poultry					
Bee Colony					
Milk					
Butter					
Egg					
Hide					
Honey					
others					
Total income					

4. USE OF SOIL AND WATER CONSERVATION (plot level)

4.1 How do you perceive the income you have generated from your cultivated land?

1=Low 2=Medium 3=High

4.2 If you had practice in SWC activities; why do you select SWC activities for your farm land?

1= increase productivity 2 = access to better house hold labor 3= DAs influence 4= other specify

4.3 Before you started these SWC activities, what was the estimated annual income of your HH earned from your farm land?

4.4 What is the estimated annual income of your HH now? .....

4.5 What is the estimated annually expenditure of your HH now? .....

4.6 In which specific way(s) has this SWC activities being help to you? ----------

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5. SOURCES OF INCOME AND THEIR PROPORTIONATE CONTRIBUTION TO HH. INCOME

5.1 Do you or any member of your family engage in any Non-Farm Activity? 1=yes 0=No

5.2 If to question no 6.1 is yes, the amount of income earned from non- farm activities in 2017? ----------Birr per month

5.3 How long are you or any member of your family engaged in non-farm activities? _____ (In Years)

5.4 Household income source and yearly income (including petty trade and other income source exhaustively)

S.n	Source of income	Yes	No	Income per Month	% contribution to HH income
1	Irrigation farming				
2	Rainy season farming				
3	Livestock production				
4	Off – farm casual labor				
5	Remittances (from relatives				
6	Petty trade activities				
7	Food Aid				
9	Sale of wood item				
10	Income from social Occasions /weeding, Eddir/				

11	Self-employment in manufacturing e.g. Artisan (blacksmith, weaving, pottery, handicraft and carpenter)				
12	Others IGA (specify)				
13	Total				

6. CREDIT, INPUT AND EXTENSION SERVICE SUPPORTS IN PRODUCTION (2010)

CREDIT SUPPORT SERVICE

6.1 Have you Access to credit and saving institutions for your agricultural activities? 1= Yes 0 = Nok2

6.2 If yes, why?

1= to purchase house 2= to purchase farm implements 3= to buy modern farm inputs

4= to build house 5= to buy improved seeds 6= others (specify) -------

6.3 What is the source of your Credit?

1 = Banks 2 = Friends/relatives3 = Traders 4 = Microfinance/ ACSI) 5= Cooperative

6.4 Is credit timely and adequately available for agricultural commodities production?

1 = Yes 0= No

6.5 During the last 12 months (2010 e.c) did you have voluntary saving? 1= yes 0= No

6.6 If yes, to question 7.5 where or how did you keep your savings?

1= in my house/under mattress 4=Save in the form of jewelry

2= Traditional RUSSACO 5=Buy livestock

3= Bank 6= other (specify)

6.7 Amount of saving ----------Birr.

AGRICULTURAL EXTENSION SERVICES (2010 e.c)

6.8 Do you receive any sort of extension services available last year? 1 = Yes 0 = No

6.9 If yes, during which activities?

1= SWC activities 3 = Crop production and productivity

2= live stalk production and productivity 4= forestry and management

5. Other specify…….....

6.10 If yes to question 7.8, what is the method of extension?

0= group extension method 1= individual extension method

6.11 If yes to question 7.8, how frequent it is?1 If yes to question 7.8, how frequent it is?

1= weekly 2 = biweekly 3 = monthly 4= once in a year 5. Other specify

ACCESS TO MARKET SERVICES

6.12 Do you have access to market? 1= yes 0=No

6.13 How long does it take you access the main road from home ---------- (walking Hrs. or distance in km.)?

6.14 Did you get reasonable price for your produce at the place you used to sell to?

1 = Yes 0 = No

6.15. Do you get market information about prices and demand conditions of agricultural inputs and out puts? 1 = Yes 0 = No

6.16 if yes to 6.15 indicate the source of information.

1= personal/mobile/ 2=extension agents 3= marketing agency 4= cooperatives 5= others\specify----------

6 .17 How long does it take you to the main nearest market place from home? ____ (Hr.)

7. USER PARTICIPATION

7.1 Did you participate in the implementation of the SWC activities? 1=Yes 0= No

7.2 If yes, indicate aspects of your participation: tick the space in the raw 3 of the table

1	2	3	3	4	5	6	7	8
Soil bund	Stone faced soil bund	biological treatment on bunds and terraces	Terracing + Water collection trench	manure application	fertilizer using	crop rotation	fallowing	others, (land management activities) specify ----------

7.3 Did you participate in the public land management activities? 0=Yes 1= No

7.4 If yes, indicate aspects of your participation:

1= drafting the community water shed users regulation 2=labor investment

3= others, (land management activities) specify ----------

7.5 Do you have participated in Paid participation or not? 0= yes 1= no

8. OVERALL ASSESSMENT AND IMPACT FOR SWC USERS (perception questions)

8.1 Do you think that SWC activities have a positive effect on household livelihood condition?0= Yes 1= No

8.2 If your answer is yes, what are the positive effects of SWC that you have seen? (open ended question)……
……
……

8.3 What is your household's living condition over the last five years?

	0=Best	1= Better	3= small	4= Remain the same	5= worsened
Level of improvement					

8.4 If improved how it was improved using SWC have you observed? (Multiple answers, possible)

1= Change in the number of meals eaten per day

2= Change in the variety of food eaten.

3= Changing the amount of money spent on education.

4= Change in the amount of money spent on health.

5= Change in the amount of money spent on clothing.

6= Change in the ability to cope with draught.

7= Change in coping strategies during times of food shortage.

8= Reduce in crop failure and increase production.

9= Change in the number of products sold for income.

10= Increase employment opportunity during irrigation season.

11= others (specify) _____

9.5 What can you say about the impact of land management on your household's livelihood?

1=Very big positive impact (i.e., long term and permanent positive impact)

2=Good impact (mainly temporary benefit, but some permanent impact

3=Very small positive impact (small temporary benefit)

4= partly positive, partly negative (mixed with the overall impact being almost zero)

5=Negative impact (I got into problem as a result).

10. HOUSEHOLD AND PRODUCTIVE ASSET

10.1 Can you give financial estimate (current market value) of fixed assets under your possession?

Item	Quantity	Total value (Br.) current market price	Proportion of treated land: only for land management users (code -1)
House & Household Assets			
House(Houses)			
Telephone(mobile)			
Radio			
Tape Recorder			
Chairs /Benches/stools			
Gold			
Silver			
TV			
Solar			
Bed /wood or metal/			
Livestock			
Ox			
Cow			
Heifer			

Bull			
Calf			
Sheep			
Goat			
Donkey			

Mule			
Horse			
Poultry			
Productive Assets			
Bee hive (traditional)			
Bee hive(Modern)			
Motor pump			
Drip Irrigation			
Cart			
Mill			
Others			

Code-1

1 = Zero	6 = More than 50% but less than or equal to 75%

2 = Less than or equal to 5%	7 = More than 75% but less than or equal to 90%
3 = More than 5% but less than or equal to10%	8 = More than 90% but less than 100%
4 = More than 10% but less than or equal to 20%	9 = 100%
5 = More than 20% but less than or equal to 50%	

11. CONSTRAINTS CONFRONTING LAND MANAGEMENT

11.1 Have you practiced SWC activities in your land?

11.2 How do you express the imitativeness (supportiveness) of current land tenure system for sustainable land management?

1= very good 2= good 3=poor 4= very poor

11.2 What are the constraints that affect your participation in soil and water conservation activities in your farm?

1=water 2=land 3=labor 4= inputs 5=credit 6= market 7=pest and diseases 8=other specify

11.3 What are the major problems encountered in the use of soil and water conservation activities, what is your opinion about the solution----------
---------- ----------

11.4 What help do you need from the government or any organization on your rain fed farming? ----------
----

11.5 Is there any drought occurred in the last five years? 1= yes 2= no

11.6 If your answer is yes in question number 11.5 how often? 1= yearly 2= within 3 years 3= within 4 years 4= once in five years

THANK YOU!!!

BIBLIOGRAPHY

Yahya Kebede Yeha was born in North *Wollo* Zone at *Meket* Woreda in Amhara region, on January 1988. He completed grade 1-8 and grade 9 - 10, at Filakit town. He joined Mersa Agricultural TVET College in 2003; accomplished his Diploma in Natural Resource in 2006. He started his first job in Meket Agriculture office as Development Agent and served for five years. He joined Bahirdar University College of Agriculture and Environmental science in 2011; and accomplished his Bachelor of Science degree in Agricultural Extension in 2014 with a great distinction. Immediately after graduation, he was employed as Extension Training Monitoring and Evaluation officer on 2014 at *Meket Woreda* office of Agriculture. After he served for one year, he transferred to *Meket Wereda* land administration office and work as socio economist for one and half years the he got the chance to study M.Sc. degree in Agricultural Economics at Bahir Dar University College of Agriculture and Environmental Science. Yahya also graduated his BA degree in Sociology from St. marry university college and his LLB degree in Law from *Ethiopis* distance learning college. He joined ANRS Justice Professionals Training Institution in 2017 graduated in the same year. Starting from July 2017 up to July 2018; he works at ANRS Attorney General Office, *wereda* attorney head in *Janamora wereda* and 2019-2020 in *Meket wereda*. The author is married and has one boy.