



**ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT
STUDIES**

**CENTER FOR ENVIRONMENT AND SUSTAINABLE
DEVELOPMENT**

**WATERSHED MANAGEMENT PRACTICE AND LIVELIHOOD OF
SMALLHOLDER FARMERS: THE CASE OF HIDABU ABOTE WOREDA OF
NORTH SHOA ZONE IN OROMIA REGION, ETHIOPIA.**

BY

DAGNE ABABU

August, 2021

Addis Ababa, Ethiopia.



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THIS THESIS WILL SUBMITTED TO THE CENTER FOR ENVIRONMENT AND SUSTAINABLE
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Addis Ababa, Ethiopia.

Declaration

This is my thesis manuscript which has not been presented in any universities through researches, thesis and dissertation. In this work, the published articles, journals, books and other supportive reading materials has been used as references are appropriately acknowledged.

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This is to certify that the above declaration made by the candidate is correct to the best of my knowledge as an advisor.

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This is to certify that the thesis prepared by Dagne Ababu Bishaw entitled Watershed Management Practice and Livelihood of Smallholder Farmers: The Case of Hidabu Abote Woreda of North Shoa Zone In Oromia Region, Ethiopia, and it will submitted in partial fulfillment of the requirements for the Degree of Master of Art in Environment and Sustainable Development complies with the regulations of Addis Ababa University and meets the accepted standards with respect to originality and quality.

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Table of Content

Acknowledgment	iv
Table of Content.....	v
List of Tables.....	ix
Abbreviation/Acronyms	x
Abstract	xi
CHAPTER ONE	1
1. INTRODUCTION	1
1.1. Background of the study	1
1.2. Statement of the problem	3
1.3. Objective of the study	5
1.3.1. General objective	5
1.3.2. Specific objective.....	5
1.4. Research question.....	6
1.5. Scope and limitation of the study.....	6
1.6. Significance of the study	6
1.7. Ethical consideration	7
CHAPTER TWO	8
2. REVIEW OF LITERATURE.....	8
2.1. Operational definition of terms	8
2.2. Watershed management from common property theory.....	8
2.3. Concept of watershed management.....	10
2.4. Concept of livelihood.....	10
2.5. Watershed management practices and livelihood	11
2.6. Principle of watershed management	11
2.7. Empirical literature reviews	12
2.7.1. Watershed management in Ethiopia	12
2.7.2. Challenges of stakeholders participation in WSM.....	13
2.7.3. Watershed management practices in income creation	14
2.7.4. Impacts of watershed management practices.....	15
2.7.5. Activities implemented in watershed management practices	16
2.8. Conceptual framework	17
CHAPTER THREE	19
3. RESEARCH METHOD.....	19
3.1. Description of study area.....	19

3.1.1.	Location and geography.....	19
3.1.2.	Agro-ecology and topography	20
3.1.3.	Demographic feature of the district	21
3.1.4.	Land use land cover and economic activities	21
3.2.	Method of the study.....	22
3.2.1.	Research design	22
3.2.2.	Sources of data.....	22
3.2.3.	Sampling procedure and techniques	23
3.2.4.	Survey households sample size determination	23
3.2.5.	Methods and tools of data collection	24
3.3.	Data analysis	26
3.3.1.	Qualitative data analysis	26
3.3.2.	Quantitative data analysis	26
3.4.	Description of variables	27
CHAPTER FOUR.....		31
4.	RESULTS AND DISCUSSION.....	31
4.1.	Demography and socioeconomic characteristics of respondents.....	31
4.1.1.	Age, sex, marital status and family size.....	31
4.1.2.	Education status of the respondents	33
4.2.	Socioeconomic characteristics of respondents.....	34
4.2.1.	Sources of income.....	34
4.2.2.	Land and livestock holding size.....	35
4.2.3.	Crop production	37
4.3.	Watershed management practices implemented in study area.....	40
4.3.1.	Community participation in watershed management practices	40
4.3.2.	WSM and SWC activities implemented on farmlands	42
4.3.3.	Conservation measures carried out on grazing land	50
4.4.	Watershed management practices and its implication on yields.....	53
4.4.1.	Effects of WSM practices in study area.....	54
4.4.2.	Methods of forest conservation.....	55
4.4.3.	Livestock feed and grazing land management.....	56
4.5.	Factors constraining of watershed management practices	57
4.5.1.	Lack of training.....	57
4.5.2.	Lack of appropriate technology	59
4.5.3.	Open grazing	59
4.5.4.	Deforestation.....	59
4.5.5.	Destruction of SWC structures	60
4.5.6.	Lack of bylaw for natural resources conservation	60
4.5.7.	Inadequate extension services.....	61
4.5.8.	Insufficient (small) farmland holding	62

4.5.9.	Shortage of income	62
4.5.10.	Poor agricultural practices	63
4.5.11.	Fearing reduction of land size due to land closure	63
4.6.	Impacts of watershed management practices in the livelihood of farmers	64
4.6.1.	Contribution of SWC practices in land productivity.....	64
4.6.2.	Benefits obtained from forest/tree products.....	65
4.6.3.	Watershed management as job opportunity.....	66
4.6.4.	WSM practices and its results in study area	69
4.6.5.	Perennial crop production and WSM practice	70
4.6.6.	WSM and components of livelihood	71
CHAPTER FIVE		73
5. CONCLUSION AND RECOMMENDATION.....		73
5.1.	Summary and conclusion	73
5.2.	Recommendation.....	74
	Reference.....	77
	Annex 1: Survey Questionnaire for Sample HH.....	85
	Annex 2: Checklists for FGD.....	95
	Annex 3: Checklist for KII.....	97
	Annex 4: Af-gaaffii Afaan Oromiffaa.....	100
	Annex 5 : Conversion factors used to estimate Tropical Livestock Unit (TLU)	110

List of Tables

Table 1: Survey household sample size by kebele.....	24
Table 2: Summary of Explanatory Variables	30
Table 3: Sex, marital status and family size of survey household	33
Table 4: Educational status of survey household.....	34
Table 5: Income sources of survey households	34
Table 6: Land holding of survey households.....	35
Table 7: Livestock holding of sampled respondents by livestock types.....	37
Table 8: Description of crop production.....	38
Table 9: Agricultural input user and non-users.....	40
Table 10: Modality of survey household's participation in WSM	42
Table 11: Survey HHs participation on physical SWC measures and perception on the importance of the practice on crop yield.....	44
Table 12: Survey households implementing biological measures and their perception on the importance of the practice on crop yield.....	45
Table 13: Survey households implementing agronomic measures and their perception on the importance of the practice on crop yield.....	48
Table 14: Water resource management practiced by survey households	50
Table 15: Conservation measures carried out on grazing lands	51
Table 16: Households practicing SWC measures on non-farmlands.....	52
Table 17: Households engagement in WSM practices and its impact.....	53
Table 18: WSM practice methods and its status in study area	55
Table 19: Forest conservation activities implemented by survey households.....	56
Table 20: Livestock feed and grazing land management.....	57
Table 21: Factors constraints WSM practices	58
Table 22: Forest/trees products used by survey HHs within watershed	66
Table 23: Watershed management for rural job creation.....	67
Table 24: Changes occurred after WSM implementation.....	70
Table 25: Perennial crop and its role in livelihood support.....	71

List of Figures

Figure 1: Conceptual Framework (Own Designed).....	18
Figure 2: Location map of the study area	19
Figure 3: Agro ecology (A) and slope class (B) maps of the study area	20
Figure 4: Age distribution of respondents	31
Figure 5: Ways the households gained land	36
Figure 6: Farmers perception on their farmlands soil fertility status.....	39
Figure 7: Survey households experience on WSM practice	41
Figure 8: Contribution of SWC (graph A) in yields and comparing of yield after SWC implemented (graph B)	65

Abbreviation/Acronyms

AGP	Agricultural Growth Program
CALM	Climate Action through Landscape Management
CBWSM	Community Based Watershed Management
COVID-19	Corona Virus Diseases 2019
CSA	Central Statistics Agency
DA	Development Agent
DEM	Digital Elevation Model
EC	Ethiopian Calendar
EFCCC	Environment, Forest and Climate Change Commission
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
FTC	Farmer Training Center
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPS	Global Positioning System
GTZ	German Technical Cooperation
Ha	Hectare
HAWANRO	Hidabu Abote <i>Woreda</i> Agriculture and Natural Resource Office
HAWLAUO	Hidabu Abote <i>Woreda</i> Land Administration and Use Office
HH	Household
HHH	Household Head
IPWM	Integrated Participatory Watershed Management
IWM	Integrated Watershed Management
KII	Key Informant Interview
ND	No Date
NGO	Non-Governmental Organization
NR	Natural Resource
SLM	Sustainable Land Management
SSA	Sub-Saharan Africa
SSIASTT	SRI SRI Institute of Agricultural Science and Technology Trust
SWC	Soil and Water Conservation
TLU	Tropical Livestock Unit
WSM	Watershed Management
WSMP	Watershed Management Practice

Abstract

Natural resources have been degrading due to intensive agricultural activities in many developing countries. To rehabilitate the degraded natural resources watershed management practices has become the key approach to minimize loss of such resources. In Ethiopia the government was tried to implement soil and water conservation (SWC) measures through community campaign. The study examined the impacts of watershed management practices on smallholder farmers' livelihood in Hidabu Abote Woreda, North Shewa, Oromia regional State, Ethiopia. The study employed a mixture of qualitative and quantitative methods. Data was generated through household (HH) survey, key informant interviews, focuses group discussion and observation. The quantitative data were generated from 266 household, where the sample sized detrained by standard method. Additionally, tables, graphs, narrative method, Pearson chi-square was used to examine the association between the activities of WSM and livelihood of smallholder farmers. The analysis shows that, physical and, biological SWC measures and agronomic practices were the most commonly implemented activities to conserve natural resources thereby increase land productivities and improved smallholder farmer's livelihood. As the part of Watershed Management practices the forest/trees conservation, livestock feed and grazing land management and water sources conservation undertaken by different ways. The pearson Chi-square statistical analysis revealed that all these activities have considerable role in increasing particularly crop yields. Different factors constrained the WSM practice that include lack of training and low quality of trainings given either for extension or farmers, lack of appropriate technology, open grazing, deforestation, limited maintenance of SWC structures, inadequate extension services, insufficient (small) farmland holding, shortage of cash income to cover agricultural input costs, poor (backward) agricultural practices, fearing reduction of farmland size due to land closure for conservation. The study also verified that WSM have great role in creating job opportunity in order to enhance income and livelihood of smallholder farmers. Irrigation, cattle fattening, beekeeping, forest and tree seedling production in developed watershed and significant change viewed on socioeconomic, environment and on attitude of farmers after WSM practice implemented. The policy makers and actors emphasize on the solving the limitation through providing technical or action oriented training and awareness creation through considering indigeneus knowledge, allocation of extension service and provide materials (tools) used SWC are the key reccomondation finded.

Keyword: Watershed Management, Livelihood, Soil and Water conservation, smallholder farmers.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Watershed management practice began about 5000 years ago along agricultural activities so as to control flood and soil erosion by adjusting the water and slope along rivers banks like Yellow river in China, Nile, Euphrates and Tigris for irrigation purpose. The practices was also applied along rivers used for domestic water supply in Greek and Roman and also to restore hillside, planting trees in the Mediterranean region, where all these have great contribution to the modern watershed management practices which formally began in 19th century (Chimdesa, 2016).

On the other hand, the majority of poor farmers inhabited in the arid and semi-arid rural area who depend on rain fed agricultural for their livelihood practicing watershed management considered as solution to reduce impact of water shortage for agriculture. In this area, water shortage resulted from unreliable rainfall and recurrent drought occurrence challenging crop and livestock production is triggered by environmental degradation. Consequently, people in these areas have been implementing watershed management practices to adopt the situation (Damene *et al.*, 2013). In recent year, several studies depicted that in order to improve water resources scarcity for agricultural activities and domestic use, to ensure environmental quality and natural resources conservation and thereby improve livelihood of smallholder farmers due attention have been given for watershed management practices at global scale (Bharat *et al.*, 2005; Damene *et al.*, 2013; Damene *et al.*, 2020). It is well known that rain fed agriculture accounts about 80% of the global agricultural production and implementation of watershed management practice expected to improve water resource to raise the agricultural productivity (Sahas *et al.*, 2014).

Therefore, watershed management became key approach in developing countries like Ethiopia since 1970s to manage human activities toward natural resources and its effects on their environment. Watershed management practices implemented to conserve natural resources like water, land and biophysical resources to improve the livelihood of smallholder farmers. Watershed management practice is requiring in environmental aspect, socio-economic values,

insure food security of community with in watershed and enable smallholder farmers to cope from impact of climate change that drives water scarcity through adaptation and using mitigation strategies (FAO, 2017).

In developed countries the objective of watershed management practice is to enhance water quality and quantity and to control torrent come from hillside. However, in developing countries, the objective of watershed management is to restore and rehabilitate the degraded natural resources (Waolancho, 2015). According to Dechasa (2012), agricultural land productivities in developing countries are strongly decreased because of land degradation, which departure for poverty of rural people. After agenda 21 of Rio (Brazil Environmental Conference) the theory of harmonizing natural resources conservation and development had arisen. Accordingly, development without conservation is recognized as self-destructive and conservation without development also recognizes as unaffordable. (Sheng, 1994).

The African Highland Initiatives (AHI) is the program that emphasis on the natural resources conservation associated with integrated watershed management in many African countries including Ethiopia by improving income of community related to watershed management (German *et al.*, 2006). Subsistence livelihood of smallholder farmers could be improved by implementing practices of natural resource conservation activities within small scale watershed (Legese *et al.*, 2018).

In connection to this, Ethiopia has experienced to natural resource degradation because of overgrazing, concurrent drought, climate change, inappropriate land use and overcapacity of human and livestock population in particular area (Tesfaye *et al.*, 2018). However, starting from 1970s the watershed management practices has been started on farmlands and sloppy areas to reduce soil erosion, water scarcity, impact of flood through rehabilitating degraded natural resources by implementing watershed management practices since 1970's (Damene *et al.*, 2013; Waolancho, 2015).

The practices of watershed management effective in Ethiopia and elsewhere is associated with farmers' livelihood and maintain natural resources like water, land and forest which enhance income even if holding small farmland plot and to attain benefit like energy saving, livestock production, nursery site and gain environmental service (Tesfaye *et al.*, 2018). Consequently,

community based watershed management approach was established in Ethiopia with different guidelines and criterion. According to guidelines and criterion, firstly identifying site and implement practices provided by this approach with communities using local tools to alleviate impact of flood, water scarcity and soil erosion that contribute for the productivity of smallholder farmers (Gebrekidan *et al.*, 2020). Furthermore, in northern and central part of Ethiopia watershed management activities has been practicing in rural areas to improve deteriorated of water, vegetation and soil fertility particularly in highland areas. With this concept, in Oromia region, North Shewa Zone, Hidabu Abote *Woreda*, land degradation, fertile soil erosion and loss of natural resources have been viewed. Although this *woreda* experienced with good watershed management practices, it is not achieve until expected result (Bedada *et al.*, 2020).

1.2. Statement of the problem

Ethiopia is the country mostly affected by land degradation due to large human and livestock population and considerable areas being used for subsistence agriculture on steep slope (Fanta *et al.*, 2016). Consequently, Ethiopia begins to recognize natural resources conservation in 1970s during *Derg* regime that had been supported by international donors through soil and water conservation (SWC) program. After some years, this program shifted to the watershed context which done through integrated watershed management (IWM) approach with the aims to improve the sustainable rural resources, improved smallholder farmers livelihood and improve the environment with active involvement of affected communities (Bewket, 2003).

In an effort to scale up watershed management, micro level or small scale watershed management was proposed to be effective than large scale (macro level) watershed management. The practice aimed to alleviate natural resources degradation and poverty through restoration of degraded natural resources. Although there are good activities in WSM practice in Ethiopia, it has not yet achieved the intended objective (Chimdesa, 2016; Teressa, 2018; Mengistu *et al.*, 2020).

However, participation of farmers in watershed management practices is yet low due to the age characteristics, absence of matured training and education about benefit of watershed management (lack of awareness), lack of information, constraints from policy and strategy maker, biophysical related constraints, lack of cost associated payment for labor (incentive),

socio economic constraints, lack of technical capacity and resources are among major constraints for the practice (Agidew *et al.*, 2018; Negasa, 2020). Furthermore, farmers who have numerous livestock are not properly participating in watershed management activities which show lack of understanding about benefit of WSM (Agidew *et al.*, 2018). In connection to this, watershed management could not achieve without full involvement of local community to in WSM activities (Hadush, 2015). To encourage local communities' involvement in micro level watershed management practices implement by affected communities and government mainstreaming process, fixing the area of watershed to be watershed management implemented must be confined from 200-500ha as it is manageable (MoARD, 2005).

Moreover, different studies (eg. Agidew *et al.*, 2018; Sheng, 1994; Hadush, 2015) assessed watershed management practices in general about challenges faced to local communities' involvement in the practice of watershed management, discussed the contribution of watershed management practices to improve the socioeconomic like income generation, create job opportunity, increase productivity and improve livelihood of farmers. Furthermore, watershed management practices in natural resources protection for the purpose of increasing availability of water resource reduce land degradation and deforestation is also discussed deeply.

Natural resources degradation continues severely in the study area due to intensive cultivation activities and overgrazing. Whereas, these activities trigger loss of soil fertility by accelerating soil erosion and uncontrollable gullies have been emerged. Moreover, land fragmentation, shortage of water, deforestation and reduction of productivity resulted in the *woreda*. Perhaps, communities of the *woreda* had not have awareness and understanding as degraded natural resources like water, forest and soil are directly or indirectly affect productivity of smallholder farmers.

However, starting from 2013 the rehabilitation and natural resources conservation activities as WSM practice have been employed through campaign of local community. Local communities mobilized annually through extended message from government to *woreda* and *kebeles* to do watershed management activities like biological and physical water and soil conservation activities, using traditional/local equipment within prepared time frame that to be accomplished in thirty (30) consecutive days. Although, an expected result has not viewed, some areas rehabilitated by these activities, soil fertility and availability of water resources also improved. In

this *woreda* since 2013 different WSM activities have been done on 14,300 ha (HAWANRO, 2020). But, most of the time, activities of watershed management practices undertaken by integration of local community and professionalized expertise primarily tied with environmental protection rather than conceptualized the benefit of watershed management activities pertinent with socioeconomic value, income generation which improve farmers' livelihood and create job opportunity for unemployed. Moreover, there is the lack of awareness in farmers and expertise toward WSM practice and its benefit by assessing productivity of plot of farmland. Some farmers toppling down bunds structures which constructed by communities and release livestock to protected area. Furthermore, some farmers ignore the activities implemented in watershed management for the purpose of repeatedly cultivating plot of farmland.

There were no studies undertaken concerning the WSM practices and livelihood of smallholder farmers in study area. Regarding to this, even though examining the role of WSM practice in livelihood of smallholder farmers has been required, still there is no any investigation concerning this. Therefore, the study investigated the practices implemented and its impact on livelihood through improving productivities and benefit of watershed management practiced; identified factors constraints in participating and implementing the practices in the study area before 2021; Hidabu Abote *woreda*.

1.3. Objective of the study

1.3.1. General objective

The general objective of the study is to analyze the impact of watershed management practice for the livelihood of smallholder farmers in study area.

1.3.2. Specific objective

1. To identify watershed management practices implemented in the study area.
2. To identify factors constraining watershed management practices.
3. To analyze the impacts of watershed management practices for the livelihood of smallholder farmers

1.4. Research question

1. What types of practices implemented to watershed management in the study area?
2. What are the basic challenges faced to implement watershed management practices in study area?
3. What is the impact of watershed management practices for the livelihood of smallholder farmers?

1.5. Scope and limitation of the study

The major aim of this study was to assess the implemented watershed management practices and its impact on livelihood of smallholder farmers in the study area. In regard to this, the study have confined only in two *kebeles* of Hidabu Abote *woreda*. At the time of this study, the researcher was travelled to the study *kebeles* for attend focal group discussion (FGD), for data collection through interview and for field observation. In this study the challenges like absence of farmers for group discussion due to the fear of peace in this *woreda*, problem of logistic, problem of light, lack of network, lack of instruments which applicable for the data collection was met the researcher. Perhaps, to address these limitations, researcher was recognized to creation of awareness to stakeholder, *woreda's* and keels' leaders and request support at problem face to researcher.

1.6. Significance of the study

This study described the impact of watershed management on livelihood of smallholder farmers and identifies a watershed management practiced implemented and factors constraint to participate in watershed management activities within study area. Hence, because of no any study had been conducted concerning this topic, this study explored new knowledge, develop information for further researches that to study the linkage of WSM practices and livelihood, identify and assess the constraints of watershed management practices and implemented activities to enhance livelihood in the study area. Further more, this study used for community policy maker concerning the WSM practices.

1.7. Ethical consideration

Starting from the introduction of researcher and community of study area till the end of research process, the researcher have respected the culture, norm, perception and their idea by discretion to get detail, relevant and reliable information about the research question and the researcher used the language of the community (*Afaan Oromoo*) to create more confidentiality and honest to provided data. Moreover, formal letter of support was written to Hidabu Abote woreda governmental office from Center for Environmental and Sustainable development, College Of Development Studies, Addis Ababa University to get permission from concerned body. The explanation was given to farmer about the purpose of the research and verbal consent from the respondents was requested before conducting the interview. They were informed that confidentiality of individual farmer household information was to be ensured by using unique identifiers. There were no known risks or worries associated with the study.

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1. Operational definition of terms

Watershed: - watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel (FAO, 2017).

Watershed management: - it is the process (comprehensive conservation activities) of people guiding and organizing water, land and forest resource use on a watershed in order to provide desired goods and services without adversely affecting water, soil and vegetation resources (FAO, 2017).

Smallholder: - It articulates that small- scale farmers, forest keepers managing less than 10 ha of farm land and favoring family based agricultural system to produce consumption (FAO, 2012).

Livelihood: - It defined as the capability asset such as natural resources, financial resources, human capital and social capital support to cope and recover from natural and man-made stresses (Krantz, 2001).

Household: - It is defined as one or more person who dwells under the same roof and makes provision for his/her/their own food and essential things for living (Keilman, 1995).

Forest:- In Ethiopia, forest is defined as trees, plants and other combination bio-diversity found at surrounding and in the forest land roadside, riverside, in farm land and grazing land and existed around homestead and in park area (EFCCC, 2020).

2.2. Watershed management from common property theory

According to Kerr (2015), explained about watershed management system from the common property theory, the natural resources existed in watershed could be characterized by inclusive and exclusive resources. Inclusive resources are the common pool resources like forest, water, ponds and pasture land while the exclusive resources are includes farm land, captured run-off, individual forest or plantation. The collective action among groups in watershed management could improve productivity that the farmers earn their livelihood. Similarly conserving natural resources have potential benefit in livelihood of farmers (Bennett, 2010). Conneting to this, the socio-economic perispective shows that, significant benefits obtained from WSM as includes,

gaining more rational structure of land use, increased forest and grasslands, reduced waste land, increase the productivity of land and improve income of farmers, increase the grain production from the farmlands, reduce water and soil losses and achieve significant ecological and social benefits (Karpuzcu, 2011). Moreover, it could be create opportunity to encourage wisely use of natural resources consistent with the common goods. The favorable points in the watershed resources characteristics mentioned in here are;

“...small size, well-defined boundaries, low mobility, possible storage of benefits, predictability, feasibility of improving the resource, traceability of benefits to a management intervention, and availability of indicators of the resource condition.”

On the other hand, in watershed management faced problem due to,

“...invisible boundaries, mobility of groundwater and surface water, unpredictability and infeasibility of improvement and lack of traceability all pose challenges to collective action in many watershed cases”.

In addition to this, according to Kerr (2015), cited the conclusion of Agrawal (2001), the favorable institutional arrangement in watershed management includes, 1) rules are simple and easy to understand, 2) access locally devised rule, 3) rules are easy to enforce, 4) sanction and low cost adjudication, 5) monitors and officials are accountable to users, 6) fairness in allocation resources benefit from common resources are required. The capability of establishing these rules for groups rather than own existence indicate develop good watershed management system. Watershed management plan has prepared by local community (Walie, 2015).

Connecting to the above concept and theory, starting from 1970s and 1980s the government of Ethiopia was initiated the watershed management activities to rehabilitate the degraded rural land and conserve natural resources. Regarding this, watershed management activities contribute to resilience and coping capacity of community from risk, disaster and hazards of erratic climate variability and have greater role in agricultural productivity like rear of livestock, crop production, promote water access and quality, improve human and environmental health, modify ecosystem service, rise up socioeconomic status and all human livelihood activities (MoARD, 2005).

2.3. Concept of watershed management

Watershed is the land area which is geographically confined in the context of water flow across or through and into common stream and that has inlet and outlet of the river. Watershed can be categorized in to five, these are, macro watershed which is greater than 50,000 ha, sub-watershed which is cover 10,000 – 50,000ha, milli-watershed which is cover 1000 – 10,000ha, micro watershed which is cover 100 – 1000ha and mini watershed which is 1- 100ha. Watershed Management is the activity which to maximize production and human well beings by minimizing the hazards on natural resources within the geographical confined area in the context of watershed. On the other hand, watershed management has three major components of entities of land management, water management and biomass management (SSIASTT, ND). Watershed management processes include a) collect data about watershed and understand its status, b) identify stakeholder c) identify objective of watershed management, d) prepare and determine plan, e) implement the plan and f) evaluate its implementation. WSM is holistic due to it contain social, economic, cultural and environmental resources interact (Wang *et al.*, 2016). In comprehensive manner, watershed management practices is the framework provided for assessing the resources can be used with less hazards, shows by what these resources affected and how to use an appropriately by protecting it (FAO, 2017).

2.4. Concept of livelihood

Livelihood is formed with in social, economic, environmental context. Livelihood is not only measured by income, but it encompasses the whole situation such as the ability of resilience and coping from shock faced either from natural or man-made. Livelihoods are interdependent each other that one rely on the other (UNDP, ND). Moreover, it is means of living in human beings with different activities and comprises physical material and social resources that determine the status of living, capacity to surviving, coping and recovering from disaster (FAO, 2007; Scoones, 2009). In other word, only the agricultural productivity may not maintain the livelihood of the rural community. However, sustainable livelihood could be ensured by managing and conservation of natural resources (Krantz, 2001; Salam *et al.*, 2019).

2.5. Watershed management practices and livelihood

Watershed management practices in developing countries basically focused on natural resources and human activities that of international organization like World Bank (WB) and United Nation (UN) FAO use the watershed management approach to ensure the human and environmental benefit (Wang *et al.*, 2016). An appropriate watershed management practice has great value in contribution to the increasing of income, capital asset and improves the livelihood of smallholder farmers. In terms of livelihood strategies watershed management practices create job opportunities to encourage and diversify income from agricultural productivities, forestry and ruminant livestock with producing their feed (Turton, 2000). In addition to this, Watershed management practices have positive impacts on farmers' livelihood asset such as natural, human, financial, social and physical assets (Mengistu *et al.*, 2020).

2.6. Principle of watershed management

According to MoARD (2005), several watershed management principles had identified to make WSM inclusive. These principles are;

Participatory-the involvement of stakeholder has required at all stage in watershed management activities with the existed experience and innovative techniques.

Gender sensitive- the participation of women in watershed management practices from planning, managing and implementing activities is vital to reduce the impacts of women to survive themselves and simplify un expected strive to finding needs for consumption.

Building upon local experience, strength and what works- local communities' experiences is essential to improve the natural resources conservation and technologies with encouraging best practiced and it should be shared to other.

Realistic, integrated, productive and manageable- watershed management is realistic plan that relies on local capacity and resources. It also should be integrated of natural resource conservation that to increase benefit of community with confined manageable size watershed rather than planning on large area.

Watershed logic, potential respected- it depicts that the interaction between land use and its capacity to provide production should be adjusted. The land resources should have applicable as its characteristics, capacity and suitability to harvest improved production.

The need of flexibility at different level- flexibility is the key issue in WSM because clarity is very essential in the selection of site, identifying stakeholders, developing plan within watershed being with local community.

Cost sharing, empowerment (ownership building) - cost-sharing of stakeholders contribute for sustainability of resources by encouraging responsibility within community either by group network and individual.

Complementary food security and rural development mainstream- watershed management plan is incorporate additional basic service and social service and make benefit to all have role from these activities.

2.7. Empirical literature reviews

2.7.1. Watershed management in Ethiopia

The aim of watershed management practice is basically focuses for the setup of rain-fed agricultural productivity, conserve natural resources and to reduce poverty (Alemayehu, 2016; Habtamu, 2011). In Sub-Saharan Africa (SSA) land degradation is series issues and large amount of population inhabit in water stressed areas. The fertile soil which enables to enhance agricultural productivities have been decreasing due to land degradation caused by deforestation and non-wisely using and management of natural resources.

To alleviate the loss of natural resources the government of Ethiopia has been initiated the micro-watershed development to rehabilitate losses natural resources particularly water, soil and forest. However, the plan has been not achieving due to lack of community participation, lack of awareness, lack of technologies, due to unmanageable planning units, inadequate policy and lack of evaluation process and feedback provision (Habtamu, 2011). In this regard, the major constraints of productivity in high lands of Ethiopia are the large density of population and livestock which cause for biophysical degradation of the country (Dechasa, 2012). Furthermore,

the study of Tesfaye (2011) result shows that, effective and sustainable watershed management can take place through participation of watershed community from the beginning, ownership of communal lands into private or association holdings, integration of multidisciplinary team, demand driven, changing the livelihood of the community within the short run by generating income from on-farm and off-farm activities, establishing community watershed management institution, and giving legislative support. Additionally, the study of Dechasa (2012) indicated that, WSM plays significant role in the process of improving natural resources recovery, access to water resources and technological adoption on of the community. Moreover, the finding shows, WSMPs increase the forest and grass coverage, access of fire wood and degraded natural resources regenerated/rehabilitated due to physical and biological conservation activities and all these considerably contributed to enhance livelihood of farmers.

2.7.2. Challenges of stakeholders participation in WSM

Watershed management is an activity which unable to practice within individual of either personal or sectorial alone. Despite this, coordination of multi-sectorial with different expertise is mandatory starting from the selection of site and continuously evaluate to success the planned targets. However, in developing countries like Ethiopia coordination of stakeholders is very difficult because of the lack of skilled man power, competitive in the use of fund among researcher to make more elaborate and argue the approach of integrated watershed management. In Addition to this, problem of basic data which gathered from watershed either from farmers or different offices may not reliable and reveal the attribute of respected watershed and an attitude of rural community had not accurately developed toward benefit of watershed management. Furthermore, there is a shortage of budget, materials and political commitment to apply watershed management practices in developing country and this is the main constraint in integrated watershed management participation either by group or individual (Sheng, 1994).

Having large numbers of livestock as well as off-farm activities is negatively affecting the participation of watershed management practices. Availability of extension service which create awareness and disseminate information to people considerably required. Having land tenure, topography, group member-ship and access of credit service have significant effect on the participation of farmers in watershed management system (Mengistu *et al.*, 2020).

2.7.3. Watershed management practices in income creation

In Ethiopia basically the major livelihood or income of smallholder farmers categorized in to three. These are, on-farm; which directly tied with crop and livestock husbandry production, non-farm; which is included all non-agricultural activities and off-farm; which is an agricultural activity outside of own person's agricultural income (Kassa, 2019). The areas or site of watershed management practiced have creates opportunity for income generating to improve livelihood (Singh, 2020). Watershed management practices support all an agricultural activities including;

Crop Production-watershed management activities directly or indirectly increase the productivity of different crops which enhance the households' income and livelihood (Hadush, 2015; Mengistu *et al.*, 2020). Since, the aim of watershed management activities are support a harvesting water resources, progressively the water availability make as the crop production increase within developed watershed (Gebregziabher, 2016).

Livestock production- According to Teka *et al.*, (2020); Mengistu *et al.*, (2020), study result shows that, the appropriate watershed intervention increase livestock production by improving grass and trees the supplement for feed of livestock. This case affords milk production, with quality and quantity which have great role in the up lifting of smallholder income and livelihood. Livestock production within watershed management contributes for increase income of farmers and livelihood (Agidew *et al.*, 2018). On the other hand, since watershed management encompasses conservation of trees, shrubs, grasses and flower trees which are very important, the production of honey gained from bee colonies (hives) also increase within watershed management activities (Kumsa, 2014).

Irrigation- vegetables, fruits and grain crop production increase within watershed management in addition to rain-fed based production and this is enhance the income of farmers which support themselves to survive within watershed (Teka *et al.*,2020).

Forestry- watershed management should have been conceptualized as forest is source of income as conservation covers become recognized. Farmers use the forest as income generation by changing into lumbering, fuels and use for construction (Perez and Tschinkel, 2003).

2.7.4. Impacts of watershed management practices

Watershed management has multiple positive advantages such as conserving natural resources, increase socioeconomic of household, useful to stable micro climate and contribute to minimize the horrible climate change of the world. Regarding to this, the aim of watershed management is to collect unused water from rain and other sources through reducing runoff. Hence, the moisture of conserved area, recharge of ground water due to constructed bunds (stone bunds and soil bunds), hillside terraces, *in-situ* water capture structures like micro basin, trenches and eyebrow. Furthermore, these activities also improve the amount of surface water availability and regenerate disappeared springs significantly enable to increase within watershed. Therefore, watershed management has positive impact on the availability of water resources (Teressa *et al.*, 2018). Within watershed soil conservation activities support to increase soil moisture and soil fertility (Mengistu *et al.*, 2019).

Moreover, the activities of watershed management to alleviate runoff could intensively improve soil fertility and soil depth which is crucial for cultivation that in turn to increases land productivity in the upstream and minimize sedimentation hazards in downstream part of watershed (Agidew *et al.*, 2018). Therefore, watershed management practices are positively affect soil fertility and soil depth within developed watershed. Associated with this, improved water resources availability and increment of soil fertility reasonably improve the productive capacity of land which triggers to diversify the income of households line with agricultural productivity (Teressa *et al.*, 2018).

So far, watershed management practices could be improves the vegetation and biodiversity inhabited in watershed. According to Gebregziabher *et al.*, (2016), degraded vegetation cover and biodiversity could be rehabilitated by the intervention of watershed management that contribute to providing the firewood and fodder production with abundant species of plants. Therefore, these rehabilitated and newly generated vegetation are used to solve the trouble related with livestock feed, create the access of firewood and ensure ecological balance. Hence, watershed management activities has greater role in the conservation of vegetation and biodiversity within watershed.

A watershed management activity has positive implication in the five types of assets. These are, human capital (building capacity of knowledge, understanding and develop the level of participation); social capital (encouraging institutions and relationship of community); Financial fund (gaining credit, obtaining from WSM activities and provided from other fund); natural capital (this is encompasses plants, livestock production and cultivation) and physical capital like soil and water conservation activities (Turton, 2000).

2.7.5. Activities implemented in watershed management practices

There are several factors which were the main cause for disappearance of natural assets. These factors hug in the issues like lack of awareness, poverty, lack of infrastructure (Meshesha *et al.*, 2019), mismanagement of agricultural activities, deforestation and removals of crop residue, use of marginal land for the purpose of agricultural productivities, open overgrazing, poor understanding of water and soil conservation, population increase, shortage of cultivated land and insecure land tenure are the major caused for natural resources depletion (Tsegaye *et al.*, 2015).

Nevertheless, to mitigate the occurrences of hazards, disasters and risks from cause of these natural asset degraded, watershed management in which numerous activities could be employed is vital. These activities are agro forestry practices and using forage technology practices, soil and stone bunds with forage trees and grasses and preparing ditches along farm edges. In addition to this, the physical soil and water conservation like trenches, hillside terraces, deep trenches, micro basin, Ibro-basin and fanya-juu, constructing check dams by using gabions and stone. These physical structure could not appropriate without biological conservation measurement either sowing or planting seedlings. The traditional method to conserve soil and water like crop rotating, counter ploughing, planting and conserving bush and shrubs on the boarder of cultivated land, preparing holes around perennial crop and harvesting water are the most important practices within watershed (Gebregziabher *et al.*, 2016; Tsegaye *et al.*, 2015).

Girma *et al.*, (2020) and Hadush, (2015) concluded in their study, watershed and soil conservation activities like zero-tillage, fallowing, residue incorporation, tree-crop agro-forestry in addition with animals and farmyard manure, gully controlling, construct haring bounce and

half-moon structures, use cut and carry system, irrigation practices, rehabilitate grazing lands, use improved inputs and preparation compost can intensively improve soil fertility.

2.8. Conceptual framework

As discussed above, watershed management is the holistic activities in how conserving the natural resources like water, soil and forest for current best ways using without compromising for future generation. To achieve this target community mobilization through affording different training, awareness and sharing information has required.

The policy and resources are required in watershed management practices to encourage participation of local community by using principles of watershed management. Moreover, technologie including physical soil and water conservation activities, biological activities and agronomic activities are crucial to enhance and achieve the objective proposed which increase the productivity of smallholder farmers. In this way, because of the lack of sophisticated technologies in our country to use watershed management measurements, using the local or traditional materials such as plough, axe, hoe, hammer and etc to construct physical structures of water and soil conservation like soil bunds and stone bunds which increase the water availability, rehabilitate the degraded natural resources, increase soil fertility and that support the productivity, raise the local community participation by providing training and discussion.

These whole activities improve on-farm, off-farm and non-farm productivity in general and agricultural productivities in particular (eg. Crop, livestock, irrigation, forestry) that promotes the income (in capital) and awareness (knowledge) of community. The income level can diversify the livelihood of households (Andrew, 2018). The level of income and knowledge of HH contribute to diversified livelihood of the farmers which enable to resilient and cope from natural and man-made shocks and enhance human capacity and knowledge to initiate in the participation of watershed management practices. The government mainstreaming and expertise's commitment is very important to implement the government policies. The political commitment action by national government has primarily required to success intended plan in WSM (FAO, 2017).

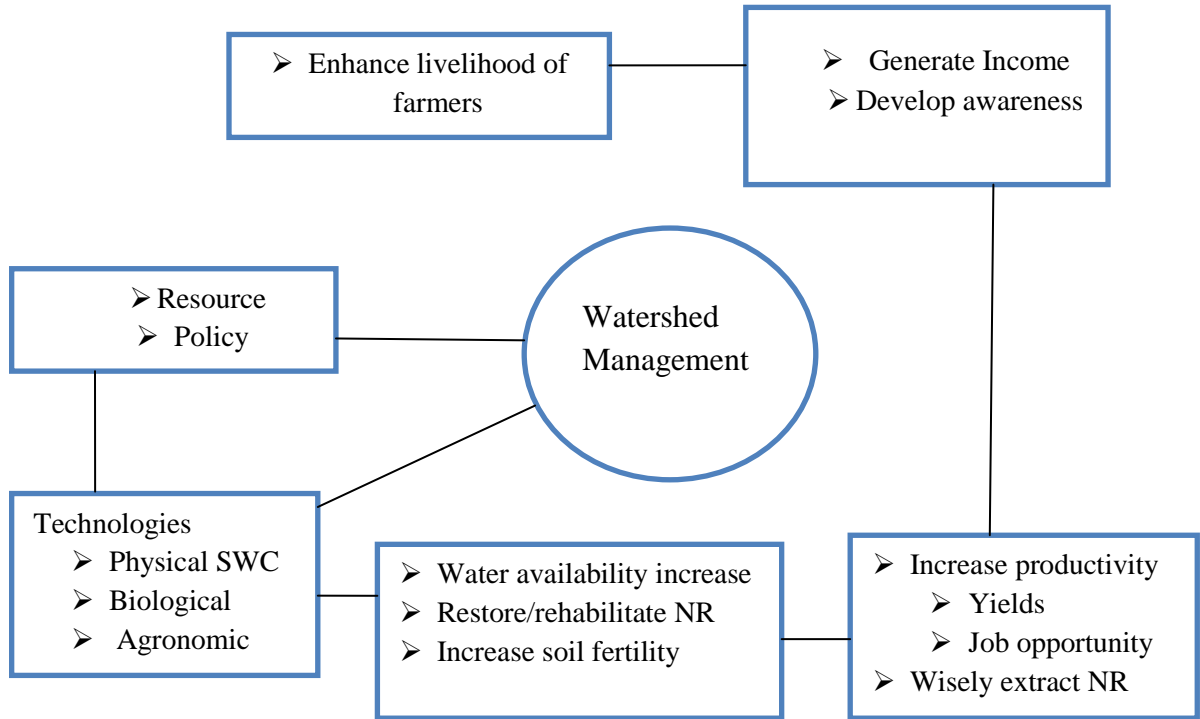


Figure 1: Conceptual Framework (Own Designed)

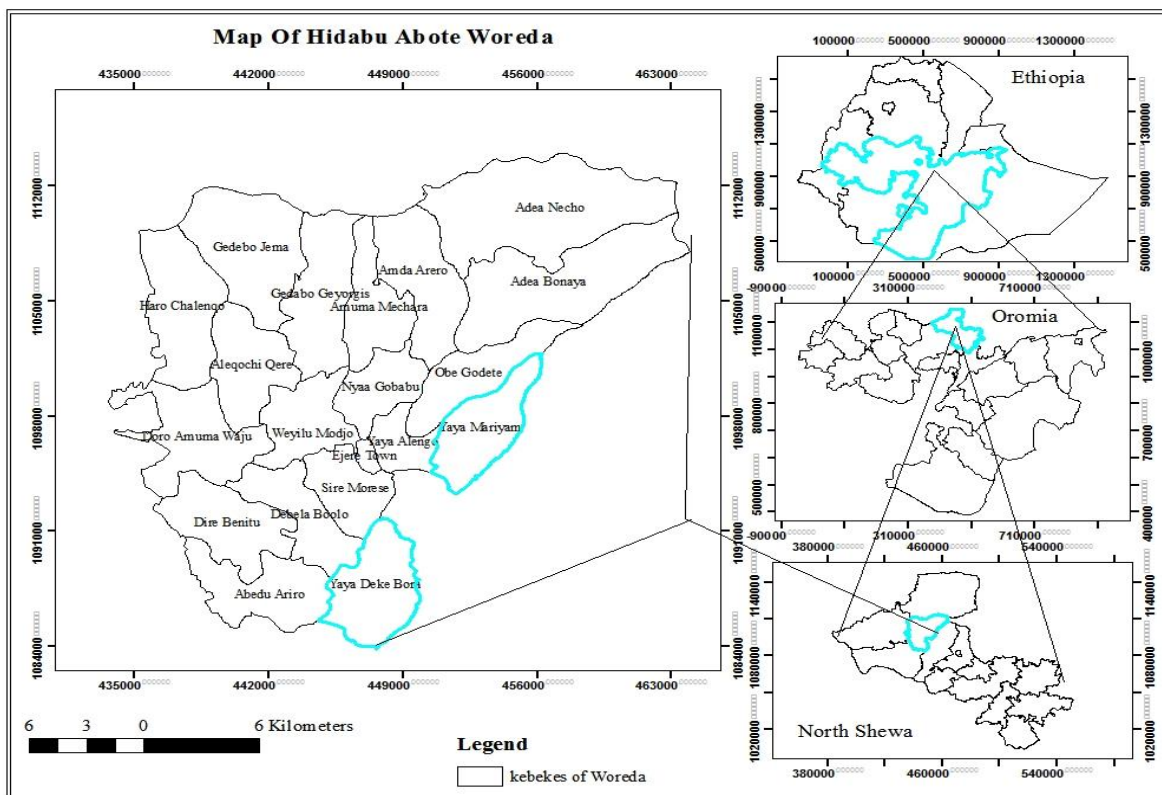
CHAPTER THREE

3. RESEARCH METHOD

3.1. Description of study area

3.1.1. Location and geography

Hidabu Abote *woreda* is located in North Shewa Zone, Oromia regional state, Ethiopia. In geographical term the *woreda* is located between 9°48'30" –10°4'40"N latitude and 38°24'00"– 38°40'12" E longitude at about 147 km from the national capital, Addis Ababa to north direction and 42 km from zonal capital, Fitcha (Figure 2). The town of the *woreda* is Ejere and the *woreda* has 19 rural and 1 urban *kebeles*. Namely, the study *kebeles* include Yaya Marami and Yaya Dhaka Bora.



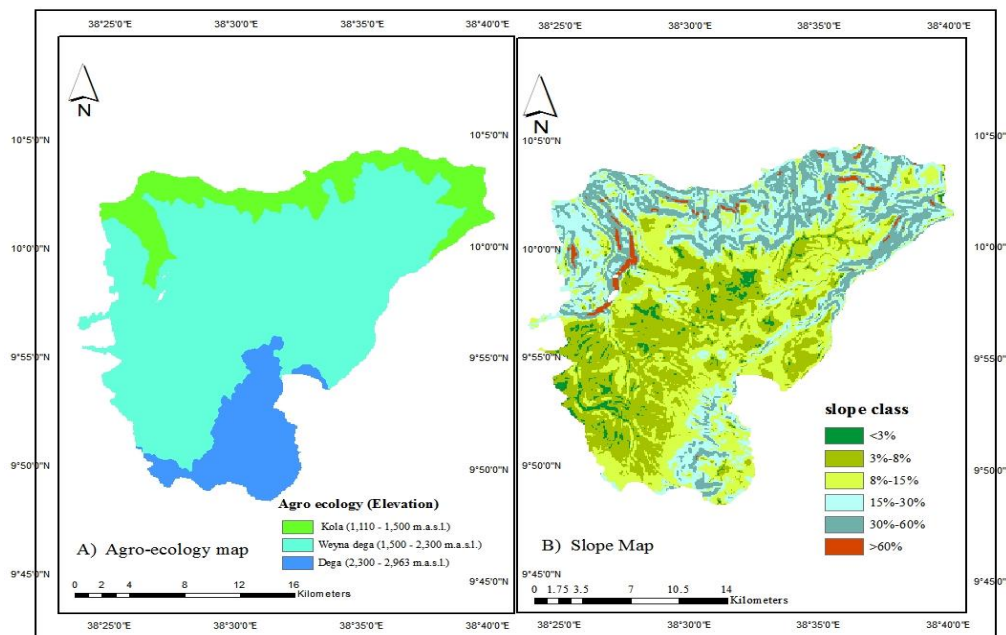
Source: Ethio-GIS, 2013

Figure 2: Location map of the study area

3.1.2. Agro-ecology and topography

The agro-ecological zone of the *woreda* stretches between *dega* (cool, humid highlands, 2300 to 2963 m a.s.l.), *weyna dega* (mild, sub-humid highlands, 1500 to 2300 m a.s.l.), and *kola* (warm, semi-arid, lowlands, 1110 to 1500 m a.s.l.) that cover about 12.9%, 73.4% and 13.7%, respectively (Figure 3). Digital elevation Model (DEM) data based analysis, the study *woreda* has very diverse slope, ranging from flat lands (<3%, mostly physical SWC not required) slope that account 8% up to very steep (>60%) slope although the proportion is too small (<0.1%). Area having slope from 3-8%, 15% - 30% and 30% - 60% account about 45.9%, 17%, 23% and 6% (Figure 3). From these we can learn that majority of study *woreda* need proper watershed management and implementation of SWC practices (DEM data analysis using ArcMap).

The topography of the *woreda* is rugged and up and down feature that contain several sub watersheds which contribute to major rivers. High land part of the *woreda* provided water for downstream and more eroded than the middle part. Middle part of this *woreda* is potentially productive, less soil erosion visible and it contribute huge yield of crops productivity either for consumption or for market. Lowland part of the *woreda* following Jemma River extensively covered with bushes, shrubs and some agricultural plots and grazing land which is less productive due to the large amount of soil erosion (HAWANRO, 2019).



Source: Generated from DEM data

Figure 3: Agro ecology (A) and slope class (B) maps of the study area

3.1.3. Demographic feature of the district

According to CSA (2007), the total population of the *woreda* is 104,442; from this about 51,030 (48.8%) are males and 53,412(51.2%) are females and the households depend on agriculture. As per the *woreda* report, the total numbers of households are 15,086 of which of nearly 89% (13,396) are male headed and the remaining (11%) are female headed.

3.1.4. Land use land cover and economic activities

According to the report of HAWLAUO (2020), the total area of this *woreda* is 50,381.9 ha and four major watersheds stretched from south direction to north ward aspect that contributes to Jemma River. The major watersheds of this *woreda* are *Indiris* and *Aleltu* river watershed, while *Bite* and *Lega Bofa* is the minor river watershed. The major land use/land cover (LULC) of the *woreda* include farmlands (rainfed and irrigated), forestlands (plantation and natural), shrublands, grazing/grasslands, settlements, bare lands and other miscellaneous land uses/covers. According to *woreda* Land Administration and Use Office (2018) report, the proportion of land under different LULC varies ranging from 58.4% (covering 29,428 ha) in cases of farmlands to 0.7% (that covered 355 ha) in cases miscellaneous LULC types. The second LULC next to farmlands are settlements that covered 8,446.5 ha or account about 16.8% of the overall LULCs and followed by shrublands (4,236 ha), forest lands (4,032 ha), grazing/grasslands (2,868 ha) and bare lands (1,016.4 ha).

On the other hand, since the agro-ecological area of the *woreda* is suitable for agricultural productivity, farmers basically rely on mixed agricultural system by engaging both on crop and livestock production. Therefore, the mixed agricultural system is the major economic means that employed by majority of the smallholder farmers, but the farmers basically depend on traditional ways. The major crop types produced in the *woreda* include: teff, sorghums, wheat, barley, maize, pea, beans and other vegetables produced using small scale irrigation like potato, tomato, green pepper, cabbage, lettuce, beetroot and onion. Moreover, livestock production also practiced, which include cattle, goat, sheep, horse, donkey, poultry and beekeeping. The *woreda* mainly covered by clay (51%), silty (35%) and sand (14%) soil types whose pH ranging from 4.5 to 6.8. The *woreda* also has diverse climatic condition where the annual mean temperature is

ranging from 13°C to 20°C and the mean annual rainfall varying from 800 to 1200 mm (HAWANRO, 2019).

Watershed management activities have been practicing through campaign of community annually by initiating the participation of local people as time frame arranged by government for activities in each *kebeles*, which have been taking place for thirty consecutive working days once annually during agriculturally slug periods with technical support from development agents (DAs), *woreda* expertise and supervisors.

3.2. Method of the study

3.2.1. Research design

In this study, the descriptive research design was employed. The descriptive research design can describe the detail of pertinent issue and add the new knowledge or information (Lima *et al.*, 2011). Therefore the study aims to describe about watershed management practices and livelihood using cross sectional study. The study used qualitative and quantitative data generation approach. Quantitative data collection method is primarily based on approaches to collect data which relate with numeric information such as socioeconomic and demography of smallholder farmers. Similarly, qualitative data collection method was also the approach that the data to be obtain through interview, focus group discussion, captured images and videos, field observation and text notes which count as primary data to support and validate the data gained via quantitative route.

3.2.2. Sources of data

A source of data for this study was the primary and secondary data sources. Primary quantitative data were gained from household survey focusing on watershed management practiced by smallholder farmers and concerned expertise. Additional information tracked through focused group discussion (FGD), Key informant interviews (KII) and field observation. On the other hand, secondary data were also gained from different reports which helpful to address the objective of the study and explored implemented activities, identify constraints and examine role of watershed management in smallholders' livelihood.

3.2.3. Sampling procedure and techniques

In the study, a multi-stage sampling technique was applied. Therefore, firstly the *woreda* was purposively selected and then from 19 rural *kebeles* of the *woreda* two *kebeles* were purposefully selected. Selection of sample *kebeles* based on criteria, i.e., agro-ecology and experience in WSMP. As more WSM intervention exist in *weyna dega* and *dega*, one *kebele* selected from each with due consideration to geographic distribution (Figure 2). The main cause to selection such agro-ecology was to examine different watershed management practices implemented in study area. Perhaps, the practice implemented at each agro-ecology may slightly different. Regarding to this, high land areas obtain more rain than other. Therefore, the practices which is compatible (for instance, outward hill terrace and other structures which is used for condensation and refine water) at high rain fall have employed in high land agro-ecology and leveled structures has implemented at *weyna dega* area. Thirdly, sample of households of two *kebeles* were selected by using simple random sampling technique using community list of the *kebele*. In this process, sampling interval was established and then survey respondents were randomly selected using the interval with 10% reserve so as to replaces those who were not around during interview.

3.2.4. Survey households sample size determination

To determine sample size, firstly consider as the good number of sample size is 200-500 (Glenn 1992). In this study, to get representative sample size, the formula adopted by Kothari (2004) was employed to determine the study sample size. In the study 5% precision level, i.e., 95% confidential level was applied. As shown in table 1, their estimation yielded 266 sample sizes using the formula given below. In order to ensure sufficient data collection, large number of sample size considered to minimize error occurs in the study. From the total of HHs of 1185 in the two *kebeles*, sample size determined using the following formula.

$$n = \frac{z^2 pq}{d^2} \dots\dots\dots \text{Kothari (2004)}$$

n = Desired sample size

z = standardized normal variable at required level of confidence of 95% CL (1.96)

p = the proportion of sampled HH to target population (0.224)

$q = 1 - p$ is the result of: 1-p value (0.224) which is (0.776)

$d^2 =$ degree of precision level (0.05)

In the above, sample size has determined by using the given formula and from these 266 sample size of both *kebele*, researcher has determined the sample size proportion of population for each *kebele* by using the following formula.

$$P_i = \frac{n_i}{N} \quad \text{where, } P_i \text{ is proportion of sample size in each } kebele,$$

$$n_i \text{ is sample size}$$

$$N \text{ is total number of target population}$$

$$\text{Then, } P_i = \frac{266}{1185} = 0.2244$$

Therefore, for *Yaya Dhaka Bora*; sample size is $645 \times 0.2244 = 144.7 \approx 145$

For *Yaya Marami*; sample size is $540 \times 0.2244 = 121.2 \approx 121$

Table 1: Survey household sample size by kebele

No	Sampled Kabeles	Total HH	Sampled HH	Per cent(%) of sampled
1	Yaya Daka Bora	645	145	54.5
2	Yaya Marami	540	121	45.5
Total		1185	266	100

Sources: Formulated From Gained Information (2021).

3.2.5. Methods and tools of data collection

Household survey

These are designed to collect and record information from many people, groups or organisations in a consistent way (Simister, 2017). In the household survey, open ended and close ended questionnaire was prepared for sample HHs. The questionnaire were first prepared in English and it was critically reviewed to adjust with objective of study and secondly all prepared questions translated into the local language (*Afaan Oromo*) so as to facilitate clear understanding between data collectors and respondents. This questionnaire enabled the researcher to obtain relevant information from respondents regarding the socioeconomic characteristics of

respondents, watershed management practices, to identify the practice implemented for watershed management, perception of community toward watershed management practice. Furthermore, information concerning the constraints of watershed management practices also included since it is basically applicable for the study. These constraints related with community participation in watershed management practices, lack of skilled man power, lack of awareness and knowledge how to convert protected areas into income generation, the role of watershed management practices and livelihood of respondents was collected.

Key informants' interview (KII)

An interview is the most common tool used in in the study with one person at a time (individual interviews) or groups of people (Simister, 2017). In addition to questionnaire, key informant interviews (KIIs) were employed. KII participants were Development Agents (DAs) of *kebeles*, Agricultural and Natural Resource Office and Environmental Protection, Forest and Climate Change Authority expertise and leaders of *kebeles* to get more accurate data. In total, 13 KII were conducted, i.e., with 4 DAs, 4 from Agriculture and Natural Resource Office and Environmental Protection, Forest and Climate Change Authority Office, 2 *kebele* leaders, 1 from *woreda* leader and 2 from leader of watershed committees. The KII were guided using checklist prepared for this purpose, which include issues that need further elaboration that can't covered through survey and FGDs. The KII checklists were prepared differently for each mentioned above interviewees according to their capacity to explain and understanding more detail to explore more knowledge. Means that, the interview question prepared for farmers, expertise and sectors head have distinguished as per their knowledge and qualification to explain broadening pertinent issues.

Focus group discussion (FGD)

Focus group discussions (FGDs) are discussions that held with a small group of people who have knowledge or interest in a particular topic. They are used to find out the perceptions and attitudes of a defined group of people to get more detail information (Simister, 2017). The research used focus group discussion as primary qualitative data sources. In total, 4 FGDs conducted in the two sample *kebeles*, the FGDs conducted in each *kebele* were one woman and one men group. Each FGD were organized from different age and social status group (poor, rich, community leaders)

and employed from different community groups representing *kebele* administration, religious leaders, elderly adults, youths and community elder. Due to COVID-19, the number of participants in each FGD was limited 6 to 8. FGD was guided by checklist that focus on watershed management (WSM) practices, their experiences, its benefit, challenges faced in the implementation of WSM practices, and contribution of WSM practices for livelihood of smallholder farmers. The data generated through FGDs were properly noted and transcribed using template prepared for this purpose. The FGDs were also supported by voice recorded in order to reduce information linkage while tacking note. All FGD participants consent heard concerning uses of voice recorder.

Field observation

Researcher employed field visit to substantiate gathered data through questionnaire, key informant interview and focus group discussion. To acknowledge the collected information eight field observations (four times each *kebele*), with assistant was visited to understand the realistic situation exists in watershed within both *kebeles* by using check list and camera. During this field observation, additional information such as the trend, problem encountered in the participation of community in watershed management practices, watershed management practices previously done, changed visible outcome like rehabilitated forest, soil and water conservation measurements like stone bunds, soil bunds, moisture conservation structures were assessed.

3.3. Data analysis

3.3.1. Qualitative data analysis

After the accomplishment of data collection and data entry to computer it was proceed to data analysis and interpretation through different ways. Accordingly, non-numeric data (qualitative data) obtained from interview, focus group discussion, captured images and videos, field observation, text notes and recorded was analyzed and interpreted through narrative and framework interpretation by explaining deeply.

3.3.2. Quantitative data analysis

The collected quantitative data through household survey were cleaned, edited and coded and analyzed using STATA version 14 and excel software. The numeric related data collected

through survey were analyzed through descriptive statistics using tabular, graphs, Pearson Chi-square test was employed to estimate the association and compare the mean differences between variables between independent (explanatory) variable denoted by 'X' and dependent variables denoted by 'Y'.

3.4. Description of variables

In the study, dependent variables were being the livelihood of respondents and independent (explanatory) variables are identified that affect participation of smallholder farmer in watershed management practices and their livelihood as follows.

Age of household head: Age is continuous variables which measured by year. Age can determine the active participation in watershed management practice and generate income from protected area. The capacity of older and youth is different due to the age of and it has negative impact in watershed management activities (Mengistu *et al.*, 2019)..

Sex of household head: Sex is dummy variable that could be labeled by 1 and 0. It is 1 if the household head is male and it 0 if the household head is female. Although the female farmers have several works either in domestic or outside, their participation in watershed management practices is low comparing with male farmer. Therefore, being male household head has positive impact in watershed management activities and being female house head has negative impact in these activities (Agidew *et al.*, 2018).

Education level of household: Education is continuous variable which measured by formal education. Hence, educated and non-educated farmers are different in the adoption and having knowledge of multi-dimensional benefit of watershed management activities. Therefore, level of education has positive impact on the understanding and participation of farmers in the watershed management activities that satisfactorily capture the knowledge. Education level has significantly positive impact to initiate the knowledge of adopting new technologies (Mengistu *et al.*, 2019).

Family size: It is continuous variable which measured by total members of the family those living under one roof and headed by one person. The participation of large number of family size

in watershed management activities is greater than small family size. The member of large family size could be involves in watershed management practices because they may not busy by other work like small family size. Therefore, size of family has positive impact on watershed management activities. According to Mengistu *et al.*, (2019), large family size was more likely intensify the use of watershed management activities.

Land holding size: This variable is continuous that measured by hectare. The farmers who have large size of land are deciding to actively participate in watershed management because they want to get the more production from their cultivated land. Therefore, having large land size has positively affected the watershed management activities and farmers prefer gaining agricultural productivities like crop and livestock production. According to Agidew *et al.*, (2018), Farmers who have large amount of farm size effectively participate in watershed management to increase their agricultural productivity.

Total livestock holding (TLU): It is continuous variable which require for multi-purpose basically in rural household. The farmers who have large amount of livestock are not need to the activities and implementation of watershed management because it is restricted to release livestock to protected watershed. Therefore, the owners of large livestock farmers are not require or not interested to implementation/participate/ in watershed management practices. Having large amount of livestock is negatively affecting the participation of watershed management practices (Mengistu *et al.*, 2019; Agidew *et al.*, 2018).

Experiences: It is continuous variable which measured by year. This refers to the total year of experience of farmers in the participation in watershed management activities. Long year experienced farmer in these activities has obtained knowledge about the benefit of watershed management practices particularly in the production of crop and diversify feed of livestock. Therefore, experience has positive impact in the participation of watershed management.

Participation of WSM practices: It is dummy variable that showed by 1 and 0. If the farmers have active participation in watershed management it will be 1 otherwise it will be 0. Involvement of farmers in these practices enables them to develop their knowledge and understanding toward benefit of watershed management. Therefore, participation constantly in

these activities has positive impact in knowledge of farmers about the benefit of watershed management.

Access to extension service: It is dummy variable that refer by 1 and 0. If the household head are access to extension service concerning to watershed management it was 1 otherwise it will be 0. The extension services provided by the government workers permanently employed at *kebele* level such as DAs (development agent), cooperatives, rural land administration and use and healthy extensions are contribute in capacitate the awareness of household. According to Mengistu *et al.*, (2019); Agidew *et al.*, (2018), the frequency of contact of extension services has positive impact on the implementation of watershed management activities due to sharing information and skill for the household engagement.

Sources of income: It is continuous variable that refer sources of income. The sources of income of household could be from on-farm, non-farm and off- farm. The household whose their income depend on on-farm have a knowledge and understanding rather than others. Fortunately, sources of income that relate with on-farm have positive impact on watershed management (Agidew *et al.*, 2018).

Training services: It is dummy variable which refer by 1 or 0. If household head gain train services it will be 1 otherwise 0. Training is very useful to obtaining knowledge and information about watershed management. Therefore, training has positive impact on the engagement of watershed management (Agidew *et al.*, 2018).

Table 2: Summary of Explanatory Variables

Code	Definition of variables	Types of variables	Measurements	Expected value
AGE	Age of Household Head	continuous	Year	-
SEX	Sex of Household Head	Dummy	1 and 0	+
EDUC	Education Level Of Household	continuous	Year	+
FAMSIK	Family Size	continuous	number	+
LNDHSIZ	Land Holding size	continuous	hectare	+
TLU	Total Livestock Holding	continuous	Number of livestock measured in TLU	-
EXP	Experiences	continuous	Year	+
PWSMP	Participation of WSM Practices	Dummy	1 and 0	+
ACCTEXSER	Access to Extension Service	Dummy	1 and 0	+
SOINCOM	Sources of Income	continuous	number	+

Source: Own definition depend on above discussion (2021)

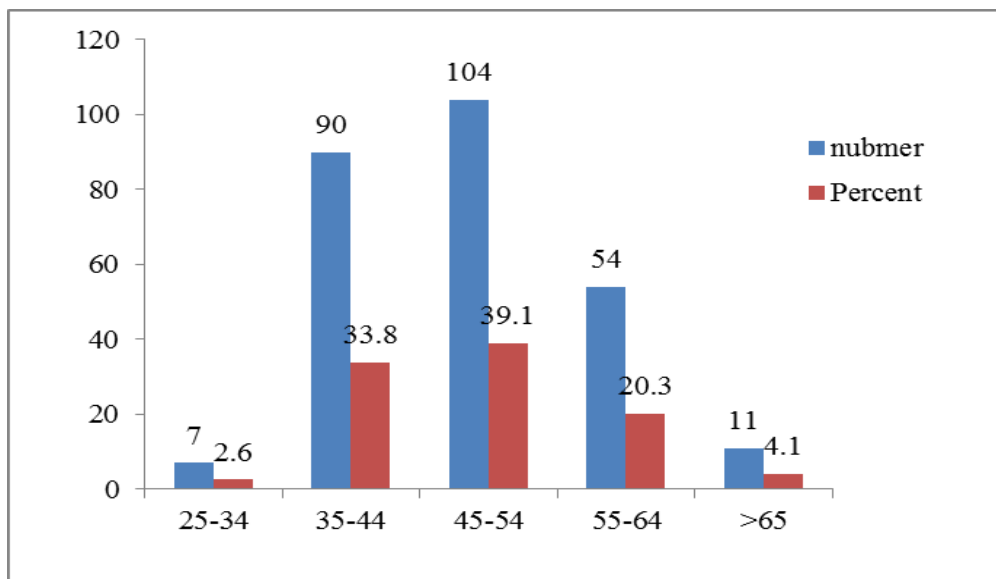
CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Demography and socioeconomic characteristics of respondents

4.1.1. Age, sex, marital status and family size

As shown on figure 4, those belong in 25-34 years counts about 2.6% of total sample. The great majority (72.9%) found in 35 - 44 years (33.8%) and 45 - 54 years (39.1%), while those who are in 55 - 64 and over 65 years account about 20.3% and 4.14%, respectively. This tells that the majority of sample households in active working age who can actively involve in watershed management activity if not impaired by health or other physical reasons, as active working age ranged between 16 and 64 years (Admassie *et al.*, 2015). The result of FGD shows that age is determine an actively participation of farmers in WSM practice which means that the older and younger person can't practice any development plan like WSM activities. The average age of respondents was 47.5 years that ranged between 25 and 73 old, i.e., the minimum respondents' (HHH) age was 25 years and the maximum was 73 years.



Sources: own data survey (2021)

Figure 4: Age distribution of respondents

As shown in Table 3, among the 245 respondents only 21 respondents were female. Of these participants, all interviewed male and female indicated were head's of the households. The results

of FGD shows, male farmers participate as compared to female farmers in WSM practice. The marital status of the survey households was also assessed and it was found that the majorities of respondents were married who coexist with their family. The analysis shows that, the respondents coexist (live together) with his/her husband/wife count about 94%, while the remaining 6% were divorced. The single, widow/er and polygamous respondents were not found during the data collection.

The study finding revealed that the minimum family size was one member and the maximum family size was consisted 9 members. According to this analysis the average or mean of family size was 5.0 which were slightly greater than the average family size of Ethiopia, which is 4.7 members (CSA, 2007). Age structure of each household shows, about 41.4% family members of the survey of respondents' were in non-working age, i.e., less than 15 years, while the greater majority (58.3%) of family members were in productive labor which their age was belong from 16-64 years.

The result of FGD indicated that, the number of family size is determining the participation of farmers in WSM prtices. As a result, participation of large number of family size in watershed management activities is greater than small family size. As most rural Ethiopian households, very few (0.3%) were older which their age fallen above 65 years old. The Ethiopian age structures shows that, below 15 years and above 65 years are dependent population whereas the ageing from 16 to 64 years are productive or working age (Admassie *et al.*, 2015).

Table 3: Sex, marital status and family size of survey household

Characteristics	Categories	Frequency (N)	Percentage (%)
Sex	Male	245	92.1
	Female	21	7.9
Marital Status	Single	0	0
	Married	250	94
	Divorced	16	6
	Widow/er	0	0
	Polygamous	0	0
Family Size	<15	552	41.4
	16-65	779	58.3
	>66	4	0.3

Sources: Own data survey (2021)

4.1.2. Education status of the respondents

Table 4 shows educational status of respondents, that varies from illiterate to diploma level. Therefore, majorities (59.4%) of respondents were illiterate and 7.1% attended informal education who able to write and read. Respondents attended first cycle (grade1-4), second cycle (5-8), high school (9-12) and educated at diploma and above level account about 22.9%, 6.4%, 3.0% and 1.13%, respectively. Education is very important in rural community so as to introduces and enhance adoption of improved practice. In this regard, 66.5% (majority) of respondents either were illiterate or able to read and write only. Thus education might limit adoption and proper implementation of improved agricultural practices including watershed management (WSM). Community could not display positive attitude and matured understanding about the benefit of participation in WSM practice without having basic knowledge. Education and information is very important to execute and participate in developmental programs including WSM practices. In relation to this, Agidew *et al.*, (2018) analysis revealed significant variation of educated and non-educated farmer's participation in WSM program. Similarly, Fentie, (2013), underlined that educated farmers can easily understand and interpret the advantage of new technologies thereby speedily adopt it and are active in decision making to implement different conservation measures.

Table 4: Educational status of survey household

Characteristics	Categories	Frequency (N)	Percentage (%)
Education level	Illiterate	158	59.4
	Read and write	19	7.1
	1-4 grade	61	22.9
	5-8 grade	17	6.4
	9-12 grade	8	3
	Diploma and above	3	1.1

Source: Own data survey (2021)

4.2. Socioeconomic characteristics of respondents

4.2.1. Sources of income

According to the analysis of this study, mixed farming is main sources of income of the community and sample respondents. The survey revealed that from the total respondents about 96.6% are currently practicing both crop production and livestock rearing to support their livelihood. On the other hand, 3% of the respondents did not have livestock but engaged in crop production. Moreover, very few (<1%) respondents engaged in livestock production only as they don't have farmlands. Additionally, some respondents have additional income from off-farm activities like petty trading (0.8%), casual labour work (3.8%), skill labour works mainly in construction of chimney (14.7%) and very few (1.1 %) have salary (employed) based income (Table 5). FGD results shows that sources of income that relate with on-farm have positive impact on WSM practices.

Table 5: Income sources of survey households

What is your source of income?	Yes		No	
	(N)	(%)	(N)	(%)
Crop only	8	3.0	258	97
Livestock only	1	0.4	265	99.6
Crop and livestock	257	96.6	9	3.4
Petty trading	5	1.9	261	98.1
Causal labour work	10	3.8	256	96.2
Skilled work (chimney)	39	14.7	227	85.3
Employment/salary based	3	1.1	263	98.9

Source: Own data survey (2021)

4.2.2. Land and livestock holding size

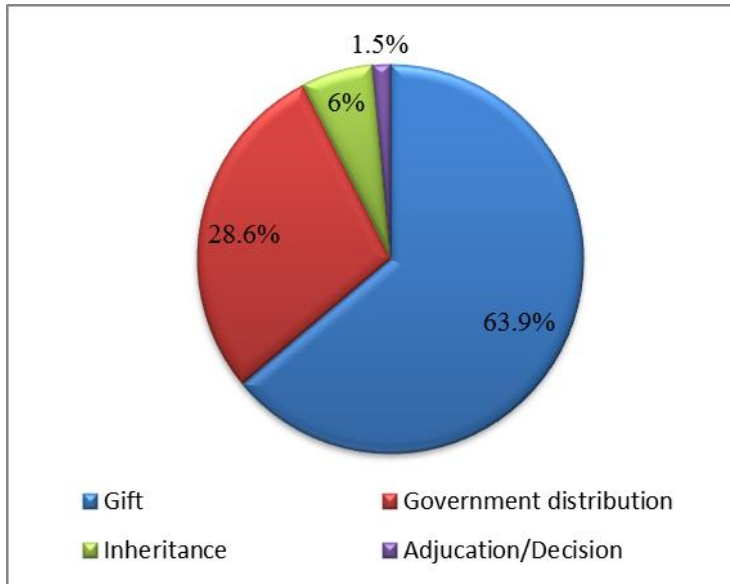
Land is the most important resources required for the farmers to insure their food security and livelihood by undertaking farm activities. As shown in table 6, almost all (97.7%) survey respondents own land but very few (2.3%) don't own. The averages land holding was 1.91 ha/HH that ranging from households which have no lands (zero holding) to those who have about 7.75 ha (maximum land holding). The average land holding by land use types of the survey respondents (Table 6) includes: cultivate lands (1.35 ha), grazing lands (0.32 ha), homestead (0.23 ha) and plantation/woodlot (0.01 ha). The average farmland holding (1.35 ha/HH) is considerably greater than regional (1.15 ha/HH) and national (0.9 ha/HH) average (Headey, 2014). The FGD report shows that having large land size has positively affect the participation in WSM activities and farmers need to gain more agricultural productivities.

Table 6: Land holding of survey households

Land owned by HH respondent	Yes (%)		No (%)		
	97.7		2.3		
Land use type	Unit	Mean	Std. Dev.	Min.	Max.
Farmland	Ha	1.35	0.988	0	4.6
Grazing lands	Ha	0.32	0.380	0	2.5
Homestead	Ha	0.23	0.182	0	1
Woodlots	Ha	0.01	0.051	0	.5
Total holding	Ha	1.91			

Source: Own data survey (2021)

The survey, FGDs and KII showed that the study area farmer's accesses land through different ways. The analysis of survey data showed (Figure 5) that 63.9% respondents acquire land as gift from their family (mainly from parents), 28.6% obtained from government during the land distribution which was conducted in 1970's, 6% obtained through inheritance (whenever parents or other family member pass away) and 1.5% obtained by adjudication/decision of court.



Sources: own data survey (2021)

Figure 5: Ways the households gained land

Livestock rearing in study area is the most important agricultural activity, which has been conducted together with crop production. The purposes of both crop and livestock production by the study community is to cover food needs, for income generation and capital creation. From the total survey respondents, nearly all (99.2%) own livestock. As shown in table 7, the average livestock holding of the sampled respondents was 2.5 Tropical Livestock Unit (TLU) that ranging from households with (zero holding) to those who own 8 TLU. The sampled farmers kept different types of livestock which include cattle (mainly oxen, cow, bull, calf, heifer), equines (horse and donkey), small ruminant animals (goat and sheep) and poultry. As per FGD and KII household produces livestock for income earning to cover household expenses and also buy grain for food whenever they face shortage from own crop production. During FGD it was tried to identify household's difference among those with few and large number of livestock to participate in WSM practice and the discussion participants indicated that farmers who own large number of livestock were not actively involving in WSM practices as they fear that the physical structures (like bunds and terraces) reduce size of grazing lands. The FGD participants opinion on variation for participation of farmers on WSM practice with size/number of livestock holding resemble with Agidew *et al.*, (2018) study findings.

Table 7: Livestock holding of sampled respondents by livestock types

Livestock type	Total amount in No	Conversion factors	TLU	Mean	Std. Dev.	Min.	Max.
Oxen	250	1	250	0.940	.793	0	4
Bull	202	0.6	121.2	0.456	.925	0	4
Cow	170	1	170	0.639	.775	0	4
Heifer	142	0.75	106.5	0.400	.763	0	4
Calves	255	0.2	51	0.192	.754	0	3
Donkey	177	0.7	123.9	0.466	.719	0	4
Goat	3	0.7	2.1	0.008	.719	0	4
Sheep	130	0.1	13	0.049	1.195	0	9
Horse	175	0.1	17.5	0.066	1.476	0	12
Mule	27	1.1	29.7	0.111	.302	0	1
Poultry	315	0.013	4.095	0.015	.106	0	1
Total			888.995	3.342			

Sources: Own data survey (2021), where TLU conversion used Stock, *et al.*, 1991 conversion factors.

4.2.3. Crop production

Crop production is the main livelihoods and income sources in study area community (Table 8). The major crop types produced in the study area include *teff* (by 63.9% farmers), wheat (63.2%), pea (42.3%), barley (42.5%), sorghum (19.9%), horse bean (12.0%), maize (4.1%) and Niger seed (0.8%). Here, it is important to note that farmers produce multiple type of crops, thus the percentage can't be added together.

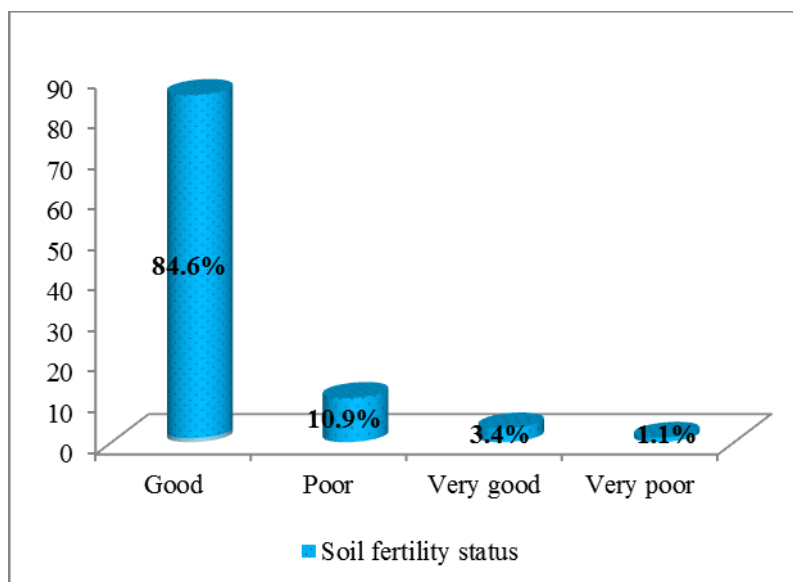
Study conducted by Taffasse *et al.*, (2013) shows, the majority of Ethiopian farmers are smallholders who cultivate small size of farmlands, thus they primarily use own production for household's consumption and supply relatively small amount to the market and connection to this, it showed that, out of the total crop (e.g., cereal, oilseed, pulse, vegetables, fruits and other cash crops) production 95% crops are produced by smallholder farmers. The survey data analysis also indicated that farmer's apply fertilizer on cereal, vegetables and fruits but not on pulses (pea and horse bean) and oilseed, mainly Niger seed (Table 8). Considerable proportion of participants apply fertilizer on wheat (59.1%), *teff* (56.8%) and barely (38.4%). These tells that more extension work required to promote soil fertility enhancement either through use of organic (compost, farmyard manure, etc) and/or inorganic (chemical) on farmlands.

Table 8: Description of crop production

Crop types	Average land size (ha) cultivated by crops in 2020/21	Proportion (%) of respondents who cultivated the crop	Proportion (%) of farmers applied fertilizer by crop type
teff	0.71	63.9	56.8
wheat	0.63	63.2	59.1
pea	0.1	43.2	0
barely	0.62	42.5	38.4
sorghums	0.45	19.9	6.0
horse bean	0.65	12.0	0
maize	0.6	4.1	3.4
Niger seed	0.5	0.8	0

Sources: Own data survey (2021)

In relation to farmer’s uses of fertilizer as per improve fertility status of their farmlands, the survey tried to capture farmer’s evaluation of their farmlands. As per the FGD, farmers uses different soil properties and other factors like their experiences, yields, topography/slope, soil depth, soil color, stoniness and water holding capacity and susceptibility for water logging so as to evaluate fertility of their farmlands’. Accordingly, 84.6% households responded that their farmland has ‘good’ soil fertility status, while 10.9%, 3.4% and 1.1% respondents evaluated the fertility of their farmlands as ‘poor’, ‘very good’ and “very poor”, respectively (Figure 6). The FGD shows that, soil fertility of farmland of all farmers was not the same so as to fertile soil have great role in crop productivity. This result was similar with the study of Agegnahu *et al.*, (2010), which shows that, improving soil fertility helps to enhance crop production and farmland.



Source: own data survey (2021)

Figure 6: Farmers perception on their farmlands soil fertility status

In the effort to improve crop production, local government has been expanding irrigation. In connection to this, 41.4% survey respondents have irrigated farmlands who majorly cultivate cereal crops (like wheat, barley and maize), vegetables and root crops mainly potato, green pepper, onion, tomato, cabbage, beetroot and carrot. The main water sources for irrigation are river diversion and small pumps.

As shown in Table 9, study area farmers also apply improved seeds and herbicide and pesticide in addition to chemical fertilizer. Although farmers don't apply chemical fertilizer to all crop type, in general, most farmers (96.6%) at least apply chemical fertilizer on some crop type. Accordingly, the survey showed that 58.3% and 87.6% of respondents applied improved seeds and herbicide/pesticide, respectively in the 2019/20 production year to improve productivity and also to control pests and disease from their crops. FGD also indicated that, applying of these agricultural input have been significantly helping in improve crop productivity. Connecting to this, agricultural extension program of government train farmers to apply input through demonstration at FTC (farmers training centers) and provision of inputs such as improved seeds, fertilizer and pesticide. Thus, these agricultural inputs would lead to ensure production and productivities (Seko, 2009).

Table 9: Agricultural input user and non-users

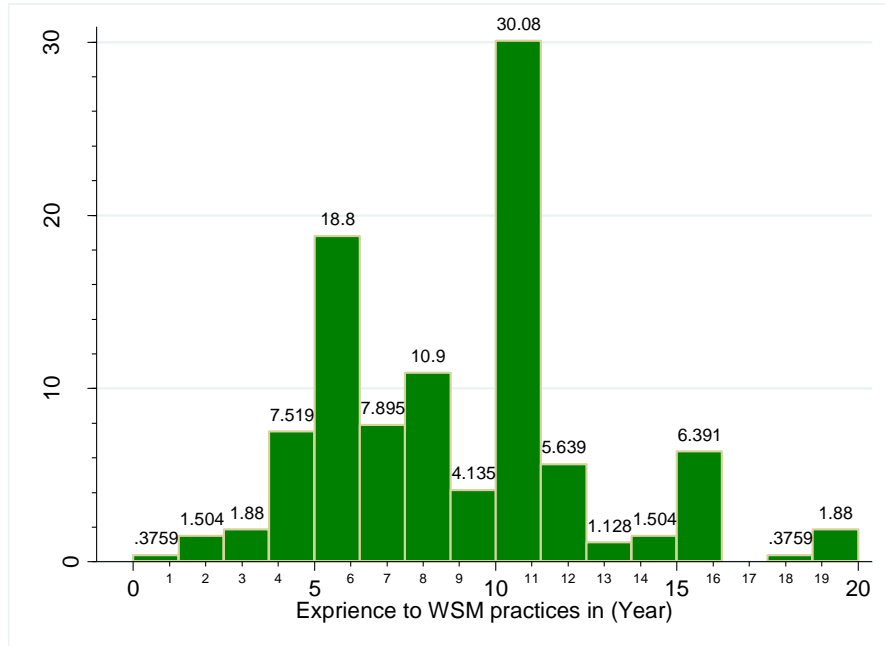
Types of input	Agricultural input users		Non users of agricultural input	
	Number	%	Number	%
Chemical fertilizers	257	96.6	9	3.4
Improved seeds	155	58.3	111	41.7
Herbicide and pesticide	233	87.6	33	12.4

Sources: Own data survey (2021)

4.3. Watershed management practices implemented in study area

4.3.1. Community participation in watershed management practices

In the study area, the sampled farmers have different experiences due to the variation in starting time of the practice. For example, as per key informant interview (KII) and focus group discussion (FGD) in *Yaya Dhaga Bora kebele*, watershed management (WSM) practice was started in 2001 through support of SLM (Sustainable Land Management) program of GIZ (*Deutsche Gesellschaft für Internationale Zusammenarbeit*), while other kebeles started very late. Hence, the experience in watershed management practice on this *kebeles* and sampled respondent has higher than other *kebeles* of the *woreda*. In the remained sample *kebele* (*Yaya Marami*) most of the respondents explained as they gained the concepts of watershed management and started in 2009 at the time of the government of Ethiopia announced community based watershed management and soil and water conservation activities through community campaign. Study area community experience of watershed management was also captured through household survey and the assessment showed that the experience of respondent mostly fall between 5-15 years (Figure 7). It was tried to verify the role experiences in WSM during FGD and discussants deeply explained that long year experienced farmer in these activities has obtained knowledge about the benefit of watershed management practices particularly in the production of crop and diversify feed of livestock.



Sources: own data survey (2021)

Figure 7: Survey households experience on WSM practice

The study analysis shows (Table 10) that about 95.1% respondents were practiced WSM activities by both group and individual bases while 4.1% and 0.8% applied the practice only through group and only individual based respectively. According to KII and FGD, WSM practices done through group based approach in which farmers organized in development team (*gare misoma* in *Afan Oromo*) to engage on degraded communal lands. The WSM and SWC activities include construction of moisture retention structures, seedling planting, construction of bunds and trenches. Recently, to achieve intended goal through WSM practices, the new modality introduced was to be established WSM committees to foster multi-stakeholder participation (FAO, 2017). In addition to this, individual farmers have been also implementing soil and water conservation (SWC) practices on their own plot of lands being organized in development group. Regarding this, FGD participants indicated that majority of farmers have been individually practicing WSM on their own farmlands, grazing lands and individually owned steep and hill areas through traditional method. This result is the same with the study of Wolancho (2015), which shows that, in order to restore degraded lands government has been implementing conservation measures through community campaign where the task led by development teams. These development teams were established to mobilize and/or motivate the participation and also tack responsibility of penalizing (punishing) in cases of absentees from

campaign work. The community campaign built bunds, trenches and different physical SWC structures with planting trees and grasses which improve soil fertility and water availability.

Table 10: Modality of survey household’s participation in WSM

Characteristics	Category	Frequency (N)	Percentage (%)
In which modality do your households participate in WSM	Individual and group base	253	95.1
	Group base	11	4.1
	Individual base	2	0.8

Source: own data survey (2021)

4.3.2. WSM and SWC activities implemented on farmlands

Base on the survey, qualitative research (FGD, KII) and field observation findings of the current study, the major WSM and SWC practices implemented on farmlands in the study area are grouped into physical, biological and agronomic (crop management) measures as detailed in the following subsections.

Physical measures

Analysis of the survey data showed that the majority of study area communities have been implementing different physical structures like stone faced soil bunds, soil bunds, stone bunds, check dam, cut-off drains and water ways (Table 11) with very few difference across the type as detailed hereunder.

Stone faced soil bunds: It is physical measure which is constructed to create barrier for runoff and slows down runoff to retain or maintain water in the soil. The practice involves supporting soil bund with stone at lower side of the bund with stone. According to the analysis in table 11, from the total respondents 92.9% practiced stone faced soil bund on own plot of lands. All survey (100%) respondents who implemented stone faced soil bund practice acknowledged importance of the structure to enhance crop production. The statistical analysis in table 11 shows that ($X^2 = 250, P = 0.000$) there is significant association between stone faced soil bunds and crop yield. Similarly, the FGD also ensured that the practices helped farmers to have impressively to improve crop yields. In relation to this, Asnake *et al.*, (2017) reported that stone faced soil bund plays considerable role in enhancing soil nutrients and moisture by reducing runoff and thereby contributed in increasing crop yield.

Soil bunds: It is physical structure done at area where stone is unavailable. Farmers use soil alone to construct bunds instead of stone to control erosion by hindering water runoff on farmlands. The survey showed that, from the total respondents 95.1% practice soil bund on their own farmlands and grazing lands particularly on farmlands that devoid of stone (table 11). Like the case of stone faced soil bund, the statistical test showed significant association between soil bund and crop yield ($X^2 = 131.29$, $P = 0.000$). From this one can deduces that application of soil bund on farmlands possibly helps to improve the livelihood of smallholder farmers. Similarly, a study of Taye *et al.*, (2015) revealed that application of soil and stone bunds significantly reduced runoff and soil erosion both on cultivation and grazing land and enhanced production and productivity.

Stone bunds: On the other hand, at the area where abundant stone available the farmers practice stone bund measures to control runoff, flood and erosion. From the total household respondents 96.2% practiced stone bunds on their own farmlands and all (100%) respondents reported that is the practice helped to enhance crop production. The statistical test of the survey data indicated significant association between stone bund and crop yields ($X^2 = 114.09$, $P = 0.000$).

Check dam: It is the small dam constructed across the water flow to reduce runoff velocity and gully development. The survey revealed that most (91.4%) respondents construct check dams whenever gully or rills developed on their farmlands by using stone, brushwood, thrush, wood log, plants like sisal (table 11). Some farmers occasionally apply gabion and cement mortar on aggressive gullies provided that they got support from government or NGOs. The statistical test of survey data analysis showed that check dam application has significant association ($X^2 = 67.28$, $P=0.000$) with the land productivity.

Cut-off drain: This structure constructed across slope of the land to intercept runoff from upstream and safely dispose to water ways or rivers so as to diminish erosion and damage of resources at downstream. The majority (95.5%) of survey respondents indicated that they are practicing cutoff drain, particularly on farmlands so as to minimize impact of soil erosion.

In general term, the statistical analysis showed that, the physical activities implemented on farmlands and grazing lands have great contribution in the crop productivities ($X^2 = 92.74$, $P = 0.000$) as confirmed by over 90% of respondents who indicated that the activities significantly

changed and improved their production. The KII and FGD also confirmed the finding of the household survey. In addition to this, KII verified that most of the farmers implemented cut-off drain, bunds and check dam by hybridizing improved and traditional methods as farmers don't get sufficient training to fully engage in improved practice.

Table 11: Survey HHs participation on physical SWC measures and perception on the importance of the practice on crop yield

Activities	HHs practicing WSM activities				Does the implementation of practice improve crop yield?			
	Yes		No		Yes		X ²	P-value
	Count	%	Count	%	Count	%		
Soil faced stone bunds	247	92.9	19	7.1	248	100	250.98	0.000
Soil bund	253	95.1	13	4.9	253	100	131.29	0.000
Stone bunds	256	96.2	10	3.8	256	100	114.09	0.000
Check dam	243	91.4	23	8.6	243	100	67.28	0.000
Cut-off drain	254	95.5	12	4.5	254	100	92.74	0.000

Source: Own data survey (2021)

Biological measures

The assessment showed that two biological measures namely planting of vegetation strips, planting physical SWC structures stabilization plants implemented in the study area. The function and adoption level of the two activities are given follows.

Vegetation Strip: It is narrow strip of plants either naturally grows or planed which laid out on contour and graded land. The study analysis indicated in table 12 shows that 27.8% of the respondents were experienced with grass/vegetation strip planting or living naturally growing plants along strips as part of WSM practice. Almost all survey households (100%) who practiced vegetation strip reported that the practice enhances crop yields. In line with this, the respondents indicated that the practices is very important in terms of improving crop yield as verified by statistical test which revealed significant association ($X^2 = 261.05$, $P = 0.000$) with the crop yield. In addition, the respondents confirmed as biological practices have impressive role in forage management, control land degradation, improve soil fertility and micro-climate.

Planting along physical structure: Table 12, depicted that from the respondents 11.7% have been practicing planting different species of trees and types of grasses along physical SWC

structures for stabilization purpose either the plants used for forage or not. Planting different species of trees and grasses along constructed physical structures like *Trilusern (adadi)*, *Sesbania Sesban*, and trees which has not negatively affect crop production like acacia species such as *Acia albida*, *garbi* and etc. Farmers who implemented the activity confirmed that planting of physical SWC structures with grass and other materials play important role in improving crop yield as it reduce frequent destruction of the structure and thereby reduce soil erosion and maintain crop yield. Analysis of data generated from respondents practicing this activity revealed as significant association with crop yield ($X^2 = 38.51$, $P = 0.000$). However, as the analysis showed the adoption of planting physical SWC structures with plant material to stabilize the structures is very low, which calls for more extension work so as to ensure sustainability of the intervention and reduce labor need to maintain the structure. KII and FGD participants also underlined that adoption of the practice is very low due to lack understanding and basic knowledge.

Regarding to this, the empirical studies results shows that, biological practices primarily elephant grass, *Sesbania sasben*, *Vetiver grasses*, *Giant reed grass* and *Sisal* grasses are important for degraded soil rehabilitation and improve soil properties. Similarly, the biological SWC interventions are very vital in order to stabilize active gullies as well as reduce soil loss from gully side (Assefa, 2020; Sinore *et al.*, 2018).

Table 12: Survey households implementing biological measures and their perception on the importance of the practice on crop yield

Activities	Households practicing biological measures				Proportion of respondents who reported that the biological measures helped in improving crop yields			
	Yes		No		Yes		X^2	P-value
	Count	%	Count	%	Count	%		
Grass/Vegetation Strip	74	27.8	193	72.2	74	100	261.05	0.000
Planting along physical structure	31	11.7	235	88.3	31	100	38.52	0.000

Source: Own data survey (2021)

Agronomic management measurements

Like most highlands of the country in the study area application of different agronomic practices is embedded in farming culture. However, some practices introduced or improved with modern agriculture. Agronomic practices implemented by study community include strip cropping, crop rotation, fallowing, retaining crop residue on farmlands, contour ploughing, and planting agro-forestry on farmlands. The technical aspects and farmer's adoption of the practices are detailed hereunder.

Strip cropping: Among several crop management practices, strip cropping is relatively minimally employed in the study area. Accordingly, as shown in table 13, the survey data analysis revealed that only 32.3% respondents have been practicing strip cropping on farmland. However, farmers who have been implementing strip cropping (100%) indicated as it is enhance crop yields. The statistical analysis result indicated that the practice has significant association with the crop yields ($X^2 = 261.05$, $P = 0.000$).

Crop rotation: Crop rotation is among cultural practice in most parts of the country including study area. Therefore, of the respondents 82% have been implementing crop rotation (Table 13). Among the respondents who practiced crop rotation, all (100%) replied that it enhance crop yield as verified by the statistical test which shows that crop rotation has significant association with crop yield ($X^2 = 266.00$, $P = 0.000$). Similarly, FGD showed that crop rotation has better benefit to increase crop yields, and improve soil fertility. However, farmland shortage jeopardized proper application of crop rotation practice, as they have to repeatedly plant crop used for home consumption.

Fallowing: It is the other culturally existing agronomic practices in the study area and elsewhere implemented for the purpose of restoring fertility of farmland. Table 13 shows, among the respondents 17.3% were applied fallowing. Although the statistical analysis test result using the data generated from farmers practicing this activity showed significant association ($X^2 = 266.00$, $P = 0.000$) between application of the practices and crop yield crop, the application level is very low. FGD result showed that fallowing activity help in self restoration of soil fertility. However, the practice has been significantly declining due to shortage of farmlands. The participants emphasized that only few farmers' particularly those who have relatively large size of farmland

have been applying fallowing. In connection to this, due to shortage of farmlands and grazing land farmers forced to cultivate their land without fallowing (Damene *et al.*, 2012; Teresa *et al.*, 2018).

Retain crop residue on farmland: Table 13 shows, among the respondents 33.1% retain crop residue on the farmlands owing its effect on crop yield as verified through the statistical test revealed significant associating between crop yield and the practice ($X^2 = 248.72$, $P = 0.000$). According to the FGD, farmers of the study area slightly practice the activity due to lack of basic knowledge about benefit of retaining crop residues on farmland, in addition shortage livestock feed force farmers to remove the residue to uses it as animal feed. This result is the same with the empirical study of Verhulst *et al.*, (2009) which repoted the removal and burning of crop residue considerably affect the soil structure that trigger to soil erosion.

Contour ploughing: It is the agronomic land management practice which is strongly tied with ploughing activities. Table 13 shows, among entire respondents 71.8% have been applying contour ploughing. Likewise, all respondents who applied contour ploughing (100%) replied as contour ploughing has considerable role in crop yields improvement. The statistical analysis in table 13 shows, it is significant association with the crop yield ($X^2 = 266.00$, $P = 0.000$). Likewise FGD results also showed that contour ploughing help in minimizing erosion and ensure suitable crop production.

Planting agroforestry on farmland: Table 13 shows, among respondents 84.6% practiced agroforestry tree planting on their own farmlands. From the respondents who practiced this activity, 100% of them aknowlaged that the practice has greate role for crop productivity. The statistical analysis in table 13 shows, application of the practices is significant association with crop yield ($X^2 = 266.00$, $P = 0.000$). FGD result also verified that planting of agroforestry trees on farmlands has impressive role for soil moisture improvment, serve as shadow to human and animals and some species used as fodder for the livestock. Therefore, this result is the same with the empirical study of Misebo (2018), which presents that, the major agronomic practices of SWC in Ethiopia were included strip cropping, mixed cropping, intercropping, contour plough, crop rotation, fallowing and conservation tillage agroforestry and these are control impact of raindrop from soil which caused splash and sheet erosion on farmland. In addition, agronomic practice have great role in order to improve and enrich soil fertility and soil stability.

According to Ali (2012) traditional SWC include fallowing, contour ploughing, retain crop residue, develop cutoff drain and ditches, mixing and strip cropping are the traditional practices to alleviate soil erosion and water loss. Consequently, these traditional SWC practices significantly maintain soil fertility, water availability, add soil moisture and enhance productivity.

Table 13: Survey households implementing agronomic measures and their perception on the importance of the practice on crop yield

Agronomic measuers	Households practicing agronomic practices				Households reported that the agronomic practices helped in improving crop yields			
	Yes		No		Yes		X ²	P-value
	Count	%	Count	%	Count	%		
Strip cropping	86	32.3	180	67.7	86	100	261.45	.000
Fallowing	46	17.3	220	82.7	46	100	266.00	.000
Retain crop residue	88	33.1	178	66.9	88	100	248.72	.000
Contour ploughing	191	71.8	75	28.2	191	100	266.00	.000
Planting agroforestry on farmland	225	84.6	41	15.4	225	100	266.00	.000
Crop rotation	218	82	48	18	218	100	266.00	.000

Source: Own data survey (2021)

Conservation practices of water resources in study area

The survey revealed that study area community have been practicing different water resources management practice like wetland protection, protecting water sources, saving water during irrigation, controlling run off, rain water harvesting and protect stream and pond/lake (Table 14).

Conserving wetland: Table 14, presented that, from the respondent households those who performed water resource management activities, about 74.8% of them were conserved the fragmented wetland on the margin of small rivers and flat plot of lands either on individual lands or communal lands which hug water and retain it for short period of time. As a result of KII and FGD shows that, there is fragmented wetlands on the mergin of farmland such as *wucale* wetland from *Yaya Marami* and *Yaya Haro* and *cange* wetlands from *yaya Dhaka Bora* were common wetland which the local community used together for grazing purpose in winter season. The observation results shows as this has these small fragmented wetlands are encroached by cultivation activities.

Protect source of water: Similarly 94% survey respondent engaged in management of water resource like springs and wells by applying different conservation practices like fencing, diverting flash flood, cleaning water ways, constructing water ways from spring and prevent livestock from it by watering cattle using fetching method rather than release to it (Table 14).

Save water during irrigation: Table 14 indicated that from the sampled household 52.2% conserve or economizes water during watering the crops and vegetable produced by irrigation. As FGD and observation report shows, some farmers used water pump generator to pull water from river or small dam and some farmers were used traditional canal and some were used small scale water canal to practiced irrigation.

Control runoff: Similarly, 92.1% respondent households conserve water resource through application of control runoff which enters to spring and small dams to minimize the impact of sediment or deposited unwanted materials that the runoff dropped in the water body (Table 14). Moreover, KII and FGD report presented that act of controlling runoff through different system trapped water and harvested runoff for cattle consumption and small irrigation aims.

Harvesting runoff water: As per the analysis of the study shows (Table 14), 88.7% of sampled household harvested water from rain and other sources like rivers, spring and wetlands. The KII and FGD reported as the activities of water harvesting have existed. Likewise, the observation result indicated that, the harvested water resource from river has the most common experiment for irrigation user of households in study area.

Water harvesting at smallholder farmers is one of the impressive strategy to solve the problem of water deficit. Likewise, protecting and conserving local water resource for the human and livestock consumption for better health and productivity and income; time saving for fetching particularly women and girl to spent for. Protecting or conserving underground water and attempt to minimize loss of water during irrigation practice with controlling runoff were the also other water management actions (World Bank, 2006).

Table 14: Water resource management practiced by survey households

Do your household applied the following water resources management practices	yes		No	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Protect wetland	188	74.8	64	25.2
Protect sources of water	237	94	15	6
Save water during irrigation	132	52.2	120	47.8
Control runoff	232	92.1	20	7.9
Harvesting rain water	224	88.7	28	11.3

Sources: own data survey (2021).

4.3.3. Conservation measures carried out on grazing land

Table 15 showed the different conservation practices implemented on grazing lands like closure of grazing lands use cut and carry system, weeding of grass land to reduce non-palatable species, use rotational grazing and construction of physical SWC. In general term, cut and carries system and weeding of grassland to reduce non-palatable species are widely practiced nearly 90.6% and 91.4% respondents respectively. Farmers keep boundaries of farmlands and hilly areas for the purpose grass production and use the grass through cut and carry system and they weed non-palatable species to improve quality and productivity of grasslands. The other activity practiced by somehow more than half (69.6%) of respondents using rotational grazing. Relatively, smaller proportion of survey households have been practicing closure of grazing lands for restoration (30.4%) and construction of physical SWC on grazing lands (13.9%). Farmers restrict livestock from grazing lands for self restoration using fences; however majority farmers do not practice closure due to shortage of grazing lands and other feed resources rather they repeatedly use grazing land even though it has been affected by overgrazing. In this regard, Bedada (2020) indicated that closure of grazing lands is effective in restoring the nutrients and quality of degraded soils.

Table 15: Conservation measures carried out on grazing lands

Conservation measures on grazing lands	Households practicing SWC activities on grazing lands				Households reported (Yes) that the SWC practices helped to improving grazing lands productivity	
	Yes		No			
	Count	%	Count	%	Count	%
Closure grazing land for restoration	91	34.2	175	65.8	91	100
Use cut and carry system	241	90.6	25	9.4	241	100
Weeding of grass land to reduce non-palatable species	243	91.4	23	8.7	243	100
Use rotational grazing	185	69.6	81	30.4	185	100
Construction of physical SWC	37	13.9	229	86.1	37	100

Source: Own data survey (2021)

4.3.4. Physical moisture retention structures on non-farmlands

The household survey, KII, FGD and field observation revealed that the study area communities have been implementing different physical and biological conservation measures. The major biological SWC measures on non-farmlands are tree plantation and closure of degraded lands as detailed under.

On Table 16, among the respondents 68.1% reported as they participated in planting forest trees as new established and conserve the existed bush and shrubs as rehabilitate and become cover the area where not suitable for farmland and grazing lands and 9.8% respondents applied closure of degraded lands for self-restoration and others didn't applied due to land shortage. Respondents who practiced these activities indicated that the practices helped in improving land productivity. Furthermore, KII and FGD participants explained that the activities have positive impact on the land productivity and livelihood of smallholder farmers.

Table 16: Households practicing SWC measurers on non-farmlands

SWC measurers on non-farmlands	Households practicing SWC measurers on non-farmlands				Households reported that the SWC measurers improving land productivity	
	Yes		No		Yes	
	Count	%	Count	%	Count	%
Forest tree planting	181	68.1	85	31.7	181	100
Physical SWC structures	28	10.5	238	89.5	28	100
Closure of land for self-restoration	26	9.8	240	90.2	26	100

Source: Own data survey (2021)

Few (10.5%) respondents reported that they are involved in construction of physical SWC structures like trench, eye brow basins, micro basins and hiring bones on communal lands.

Trenches: the result of KII, FGD and observation shows in the same manner, it is the part of moisture retention structure which is large and deep pit constructed to harvest and store runoff along the contour. In study area this structure practiced to collect water runoff. This structure has done by campaign or mass of local community on communal land, non-farmland or severely degraded areas to collect and store water. Although trenches applied for several aims, it has only performed for water collection and store to increase soil moisture of the farmland sometimes planting grass and trees on it. Similarly, trenches significantly reduced runoff and loss of soil resources both on cultivation and grazing land (Taye *et al.*, 2015).

Eye brow basin: It is circular large terraces constructed by stone at the area which have not enough rainfall. According to the results of KII, FGD and observation shows that, in study area, dried water springs and new springs emerged by the result of such like structures due to its aim is to collect and trapped runoff water particularly in *weyna dega* of study area.

Micro basin: It is small and circular structure constructed by stone for planting trees and this is also collect and trapped water runoff to increase soil moisture. KII and FGD results whows, this structure has practiced particularly on communal land by the labor participation of local community. This is employed in the *weynadaga* of study area where have medium rainfall and on shallow soil areas.

Hiring bones: It is small trapezoidal structure constructed along the contour on gentle slope to collect water runoff. In study area this was also practiced by group on communal land and severely degraded area and by this work all KII and FGD witness as the moisture of soil was improved and new springs were emerged. Similarly, half-moon and improved pit were practiced in the study area by the campaign of community on the communal land and more degraded area following respected watershed.

All presented above physical moisture retention structures have been implementing on non-farm land, communal land and severely degraded/eroded areas. Regarding this, as the KII explained that individual person did not more apply such kind of moisture retention structures due to lack of knowledge, land resource and skill to construct it. However, at the areas where these structures employed was significantly changed by soil moisture and water availability. Physical SWC structures like micro basin, improved pit, *fanya-juu* terraces and eyebrow basin have been practiced in Ethiopia in the water or rain shortage agro ecology to trap soil and water (Gadisa, *et al.*, 2021).

4.4. Watershed management practices and its implication on yields

According to the analysis result indicated in table 17, almost all (99.6%) survey respondents are implemented WSM practices in the study area to help in boosting crop yield and land productivity. Furthermore, the respondents reported the significant yields difference among lands with and without watershed management practices. The FGD findings also verified the survey finding. In addition, majority (88%) of survey respondents indicated that physical soil and water conservation measures, agro-forestry and agronomic management like minimum tillage and green manure are verified as significantly imperative crop production and land productivity.

Table 17: Housholds engagement in WSM practices and its impact

Question		Yes		No	
		N	%	N	%
Do implementing WSM on farmland change yields?		265	99.6	1	0.4
Is there difference of yield at WSM practiced and non-practiced?		266	100	0	0
Which practices applicable to increase yields?	Physical SWC only	32	12		
	Combination of all Physical SWC, agroforestry, agronomic management	234	88		

Source: own data survey (2021).

4.4.1. Effects of WSM practices in study area

Physical SWC effect: Table 18 presented respondents' evaluation of physical SWC measures on crop yield. Hence, almost all (94.4%) respondents rated physical SWC structures as highly effectiveness in improving crop yields, while the remaining respondents rated it as moderate (5.6%) and lowly (0.4%). In addition, FGDs indicated that the physical SWC structures were strongly associated with land productivity that in turn help in improving income or livelihood of smallholder farmers. KII and FGD discussants also added that following implementation of the different physical SWC structures remarkable improvement observed on the natural environment and resources which manifested through improvement in crops yield, water availability, soil fertility and soil moisture. This result is the same with study of Teressa *et al.*, (2018) which shows the physical SWC measures improved soil fertility and moisture that significantly enhanced crop yields and ensured food security of smallholder farmers.

Biological effect: Table 18 indicated that 79.7%, 12.6% and 0.8% of the respondents rated effectiveness of biological measures in improving land productivity as high, moderate and low, respectively. The FGDs confirmed that the physical structures created suitable situation for plant (including crop) establishment as it level seed beads that in turn improve farmland sustainability for cropping and improved productivity. Similarly, MoARD (2012) study finding reported that the biological and physical SWC measures are recommended to be used in combination in order to improve farmlands productivity. KII, FGD and observation shows the study area communities have been planting different tree species like *Acacia*, *Cordia africana*, and different species of grasses like *vetiver* and *dasho* grasses on the physical structure. However, the planted materials suffer from livestock damage due to free grazing practice and the animal also damage the constructed structures. In fact, the study community have bylaw to reduce the damage even if it is not well backed by law informant.

Agronomic management effect: Table 18 below indicated that about 93.2% and 6.8% of the survey respondents expressed as this activities highly and moderately important for land productivity respectively. As per KII and FGD result, agronomic management activities has highly improve productivity and aside to this it helped soil fertility, improve water availability and avoided soil and water loss by erosion/runoff during crop cultivation and irrigation activities. The main objective of agronomic measures are to cover soil degradation by applying proper

tillage practices and producing optimum biomass for increasing yields per unit of land plot. Thus, stressed on the conservation of soil fertility and aside to this improve crop yields production like food crops, fodder, vegetable, fruits and multipurpose trees to satisfy human need (MoARD, 2012).

Table 18: WSM practice methods and its status in study area

WSM activities	Importance level in productivity					
	Low		Moderate		High	
	Count	%	Count	%	Count	%
Physical SWC Activities	1	0.4	14	5.2	251	94.4
Biological Activities	2	0.8	52	12.6	212	79.7
Agronomic Management Activities	0	0	18	6.8	248	93.2

Source: Own data survey (2021)

4.4.2. Methods of forest conservation

The result in table 19 shows, 90.2% of survey respondent farmers restock the forest through seedling planting on their own plots as woodlot and communal lands. Even though, there is a shortage of agricultural (farm and grazing) lands about 91.7% of respondents indicated that they allocate part of their own degraded agricultural lands to woodlots and grass produced from the woodlots through cut and carry system. Furthermore, 94.4% of respondents reported that they retain indigenous trees like *Cordia african (Wanza)*, *Acacia abyssinica*, *Olea africana (Wera)*, *Juniperus procera (Tid)* and *Ficouse tree (shola)*, *Croton macrostachyus (Bakanisa in afan oromo)*, *Millttia ferrugines (Birbira)*, *Podocurpus gracilior (Zigba)* on farmlands. Moreover, 91.7% of the respondents reported that they have been planting and retain agro-forestry trees on their farmlands.

FGD and KII report also indicated that farmers plant and conserve tree on agricultural and communal lands for the purpose of stabilizing the local climate, control soil erosion, improve hydrology, to keep and enhanced soil moisture, to use as cattle feed and occasionally for timber production. Similarly with this result, study conducted by Amenu, (2018) revealed that forest/trees management is the combination of economic, ecological and social practices that comprise all activities to secure long-term protection of environmental services as forest provide biological diversity, soil conservation, watershed regulation and climate regulation.

Table 19: Forest conservation activities implemented by survey households

Do your household practiced the following forest conservation activities	Yes		No	
	Count	%	Count	%
Tree seedling planting	240	90.2	26	9.8
Closure of degraded land for woodlot (tree plantation)	244	91.7	22	8.3
Retaning (conserve) indigenous trees on agricultural and other lands	251	94.4	15	5.6
Planting agro-forestry tree on farmlands	244	91.7	22	8.3

Source: Own data survey (2021)

4.4.3. Livestock feed and grazing land management

As shown in Table 20, almost all (99.2%) respondents reported that they have been practicing grazing land management and applying livestock stall feeding and reduce overstocking by using storing hay and crop residue. In connection to this, from the respondents who reported that as they applied control grazing by reduce overstocking, 81.1%, 17% and 1.9% rated the role of controlled grazing reduce grassland degradation as high, moderate and low respectively. The FGD also shows whereas farmers reduce the number of livestock to manageable number by emphasizing to the livestock quality rather than quantity. Similarly, nearly the entire (99.2%) respondents have been applying livestock stall feeding by storing feeds like hay and crop residue as part of livestock feed management practice. The survey respondents rated the role of stall feeding in minimize the impact of overgrazing and grassland degradation as high (81.4%), moderate (16.7%) and low (1.9%). Regarding this, FGD revealed that, few farmers were not storing hay and crop residues rather they allow livestock to freely graze due lack of understanding.

Moreover, majority (90.6%) of respondents avoided allowing livestock at too early time on closed grazing lands (*kelo*) until the grass reached maturity level and it reduce grass land degradation. The majority (79.3%) respondents rated the role of avoiding too early grazing of closed grazing as high while 17.8% rated as moderate and 2.9% as low. In addition, 86.8% respondents applied rotational grazing practice as part of grazing land management to reduce land degradation. Consequently, 78.9% of respondent ranked role of rotational grazing as high and 18.1% rated as moderate and 3% as low. KII and FGD show that farmers applying rotational grazing are those who have enough grazing land only while those who have shortage of farmlands and grazing lands forces farmers allow their livestock for early grazing and don't

apply rotation/cell grazing. Furthermore, about half (56.8%) of respondents plant improved fodder plants such as elephant grass, *adadi*, *vetivar*, *sesbania sesba*, *bana* grass and *rodas* grass in closure areas. The survey respondents rated the role of the practice in improving forage production and natural resources degradation as high, moderate and low as reported by 87.4%, 7.9% and 4.7% respectively (Table 20).

Table 20: Livestock feed and grazing land management

Activities to control over grazing	Survey households practicing grazing land and feed managements				Role of grazing land and feed management to minimize overgrazing and grazing land management					
	Yes		No		low		moderate		high	
	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)
Control overstocking	264	99.2	2	0.8	5	1.9	45	17	214	81.1
Feeding by storing hay & crop residue	264	99.2	2	0.8	5	1.9	44	16.7	215	81.4
Avoid too early grazing	241	90.6	25	9.4	7	2.9	43	17.8	191	79.3
Using rotational/cell grazing	231	86.8	35	13.2	7	3	42	18.1	182	78.9
Using improved fodder species	151	56.8	115	43.2	7	4.7	12	7.9	132	87.4

Source: own data survey (2021)

4.5. Factors constraining of watershed management practices

The analysis identified different factors constraining watershed management practices and the contribution of the factors have variation. According to households survey data analysis the factors include: constraining vary which include lack of training, lack of appropriate technology, problem of open grazing, deforestation, destruction of SWC structures, lack of bylaw for natural resources conservation, inadequate extension services, insufficient (small) farmland holding, shortage of cash income to cover agricultural input, poor (backward) agricultural practices and fear of farmland size reduction to land closure. Detailed explanation and discussion of the different constraints are given in the following subsections

4.5.1. Lack of training

The result of this study concerning the constraints of smallholder farmers toward implementing WSM practices were clearly specified in table 21 below. According to these result, all respondents (100%) reported that neither have training nor have enough knowledge concerning

WSM. The majority (94.4%) survey respondents ranked this constraint as high (2nd) and the remaining 5.6% ranked it as moderate problem to practice and implemented WSM activities.

The result of KII with *woreda* expertise and *kebele* leaders substantiated so as the whole farmers of the *woreda* did not get enough training on WSM. FGD and KII participants indicated that few *kebele* leaders and small number of farmers obtained trainings. The trainings were focused about the general service provided in their respective *kebele*, but farmers did not obtained capacity building training concerning WSM practices. Moreover, FGD participants also indicated that the trainings have number of shortcomings in building knowledge and understanding of farmers on WSM activities. Although WSM practice essential to improve livelihood considerable proportion farmers did not practiced due to lack of awareness, knowledge and carelessness toward natural resources conservation. Study conducted by Ali (2012) and Negasa (2020) reported that some extension experts and farm households at local level don't have enough professional capacity due to lack of training.

Table 21: Factors constraints WSM practices

Factors	Yes		No		Low		Moderate		High	
	count	%	count	%	count	%	count	%	count	%
Lack of training	266	100	0	0	0	0	13	5.6	251	94.4
Lack of appropriate technology	266	100	0	0	0	0	12	4.5	254	95.5
Open grazing	266	100	0	0	11	4.1	14	5.3	241	90.6
Deforestation	173	65.1	93	35	3	1.7	13	7.5	157	90.8
Destruction of SWC structures	25	9.4	241	90.6	0	0	5	20	20	80
Lack of bylaw for natural resources conservation	16	6	250	94	2	12.5	9	56.2	5	31.3
Inadequate extension services	266	100	0	0	2	0.8	15	5.6	249	93.6
Insufficient (small) farmland holding	266	100	0	0	0	0	12	4.5	254	95.5
Shortage of cash income to cover agricultural input	266	100	0	0	5	1.9	13	4.9	248	93.2
Poor (backward) agricultural practices	55	20.7	211	79.3	0	0	12	21.8	43	78.2
Fearing reduction of farmland size due to land closure	26	9.8	240	90.2	0	0	14	53.9	12	46.2

Source: Own data survey (2021)

4.5.2. Lack of appropriate technology

Table 21 shows, entire participants (100%) replied as they don't have appropriate technologies applicable for WSM practice. From these respondents about 95.5% and 4.5% ranked (1st) the problem (constraints) associated with WSM related technology as high and moderate, respectively. In addition, KII and FGD mentioned as this problem have been seriously challenging WSM practice be it performed in group or individual base. KII with *woreda* leader and Agricultural and Natural Resources Office expertise showed that the expertise don't have adequate knowledge about the technology used in WSM analysis. Similarly, farmer level FGDs also indicated absences or shortage of important tools/material like gabion, hoe, water level, shovel and water pump generator to use irrigation are the main problem. KIIs indicated that lack of researches to investigate the main problem and new results like improved plant seed suitable for respective agro-ecology and soil type, grass and to identify the new knowledge how to practice WSM activities. In relation to this, Walie, (2015) indicated that lack of technology is the major threats of SWC practices in the means of difficulty to tillage, need much labor, need incentive to implement and reduce farm size.

4.5.3. Open grazing

In the study area, the problem of open/free grazing and releasing livestock to field was common problem. All of the survey respondents (100%) answered as the problem exist (Table 21). The great majority (90.6%) survey households rated (5th) the extent of the problem as high and the remaining 5.3% and 4.1% rated as moderate and low respectively. KIIs and FGDs also confirmed the finding of household survey that livestock allowed to freely graze on areas with WSM practice destroy biological, physical SWC and agronomic measurements. In relation to this study conducted by Wondatir, (2010) showed that most farmers in developing countries release livestock to freely graze on fields that result in over grazing and degrading the environment.

4.5.4. Deforestation

As shown in table 21, 65.1% of survey respondents revealed that deforestation is among other environmental problem in study area. People cut trees for the purpose of timber production, charcoal production and other construction purposes. The respondents who acknowledged

presences of deforestation ranked (6th)the severity of problem as high (90.8%), moderate (7.5%) and low (1.7%). KII and FGD show that, in the study area deforestation/cutting trees without any consent has been vied as farmer use the forest product to generate income and other constructions.

FDRE, (2011) report emphasized that deforestation rates in Ethiopia basically for the purpose of agricultural land expansion, fuel wood consumption and formal and informal logging and continuously increased the expansion of crop land which essentially ensures food security and poverty reduction. As the projection shows, the amount of crop land that taken from forest expected to increase over the next twenty (20) years which lead to high amount of deforestation rate. In line with this, agricultural expansion activities have negatively affect woodland, forest and bush and shrubs (FDRE, 2011). Regarding this, the increasing of demands for construction materials, fuel wood and charcoal as well as expansion of resettlement and livestock grazing negatively affected the forest resources (Eshetu, 2013).

4.5.5. Destruction of SWC structures

The survey households were asked about the role of community on sustainability of SWC intervention and accordingly 9.4% of respondents indicated that few farmers destroy constructed SWC structures, whereas the majority (90.6%) respondents reported that such act (destruction of SWC structures by farmers) has not been happening this days (Table 21). Among respondents who reported intentional SWC structures destruction ranked (8th) the problems as high (80%) and moderate (20%). Likewise, FGD participants also indicated as there is no pronounced problem of intentional SWC structure destruction in the study area. However, the study area farmers don't have proper awareness for maintenance so as to support the sustainability of constructed SWC structures particularly on communal lands. Gubreyaw, (2019) study is the same with this result shows that farmer are reluctant to maintain the constructed SWC structures on the communal land, thus the structures are destroyed during cultivation and open grazing.

4.5.6. Lack of bylaw for natural resources conservation

The analysis indicated in the table 21 shows that 94% participants indicated that lack of bylaw for natural resources conservation is not problem for sustainability of the SWC and WSM practices, while few (6%) acknowledged that lack of bylaw (traditional law) possibly negatively

affected sustainability of natural resources conservation interventions in the study area. Among survey respondents reported absences of bylaw as problem for sustainable WSM and SWC intervention 31.3%, 56.2% and 12.5% ranked the problem as its effect was high, moderate and low to constraint practice respectively. The majority of survey households who disregarded the effect of absences of bylaw for sustainability of WSM practice, they ranked the effect nearly last (10th) as it minimally constraining WSM interventions in the study area. In addition to this, KII and FGD also indicated that, this problem was too minimal in the study area because the local community established few activity based bylaws, which also indirectly applied on the broader natural resources conservation. However, few farmers disregarded, don't obedient with the bylaw, thus they cutting trees in hidden way and refuse to participate in conservation activities. In this regard, Ali, (2012) boldly underlined that traditional administration and social institution plays crucial contribution to encourage social linkage and cooperative labor in environmental protection.

4.5.7. Inadequate extension services

Table 21 shows, entire respondents (100%) indicated that the lack of extension service is among largely reported constraints or problem hindering community participation in WSM interventions. The survey households rated the problem as high, moderate and low as reported by 93.6%, 5.6% and 0.8% respondents, respectively. Thus, low extension service stand the (3rd) most important problem constraining implementation of WSM activities in the study area. FGDs and KIIs also confirmed that inadequate extension services jeopardized adoption of WSM. As per *warda* level KII the standard number of development agents (DAs) per *kebele* is three (3) who specialized in three fields namely: natural resources, animal science and plant science. However, adequate DAs did not allocated to the *kebeles* due to budget shortage to employ skilled experts. FGD participants also indicated that farmers are not getting adequate extension service particularly on WSM due to limited number of DAs. FGD participants also indicated that frequent contact with extension agents matter impact on agricultural technology and practices adoption like WSM activities implementation as extension workers give technical advice and information to farm households. In connection to this, Mogue *et al.*, (2009) research finding articulated that extension services with less qualification negatively affect agricultural practices and farming method among local community. Similarly, the study of Leta *et al.*, (2017) and

Birhanu *et al.*, (2013) revealed that the frequency of extension agent's contact with farmers enables them to understand the problem of soil erosion and benefit of WSM practices, thus enhance adoption and implementation of WSM practices. Therefore, this study investigated as the lack of adequate extension service was among the major problem for adoption and sustainability of WSM practices in study area.

4.5.8. Insufficient (small) farmland holding

Table 21 indicated that entire respondents (100%) responded reported as they have small land holding and thus farmers shy to implement WSM and SWC practices fearing that the practices took space from their agricultural land. The survey households rated the problem as high and moderate important problem respectively reported by 95.5% and 4.5% of respondents respectively that constrained implementation of WSM activities. The survey households rated land shortage (small land holding) as it stand in first (1st) rank constraining adoption and implementation of WSM activities. Farmers fear to implement WCS and WSM practices as the interventions particularly physical SWC measures reduce size of effective farmlands. The KII and FGD result also revealed that, majority of smallholder farmers don't have adequate farmlands and grazing lands so they refrain to implement WSM practice. This aligned with Abera *et al.*, (2016) finding which indicated that small size farmland holding negatively affected the land use type and farmers repeatedly cultivating without any land restoration measures. The authors added that, farmers who have large farmland size are effectively participated in SWC practices.

4.5.9. Shortage of income

Table 21 shows that, lack of cash income seriously affects the ability to bought agricultural input like fertilizer, improved seed and herbicide and pesticide to improve productivity. Accordingly the respondents (100%) reported that they don't have enough cash income to cover agricultural inputs. They ranked the extent problem as high (93.2%), moderate (4.9%) and low (1.9%) in constraining implementation of WSM and the problem stands fourth (4th) among all other constraining factors. The FGD results also indicated as farmers lack cash to cover agricultural tools and inputs. Thus it can infer that shortage of cash income negatively affects implementation

of WSM practices of in the study area. Likely, poverty is the fundamental socioeconomic problem that mostly constraint to the success of WSM activities (Negasa, 2020).

4.5.10. Poor agricultural practices

The analysis result depicted in table 21 shows, 20.7% respondents indicated that their agricultural practices is traditional (backward), but the rest (79.3%) considered as they shifted to modern. The majority of farmers applied traditional practices to control runoff like traditional ditch construction on farmlands. Consequently, from respondents classified their farming practice as poor (backward) rated the problem as it has been highly (78.2%) and moderately (21.8%) constraining adoption and implementation of WSM practices. The survey households put backward agricultural practice at seventh (7th) ranking constraining practice and implementation of WSM activities. Similarly, FGD indicated that some farmers still using backward farming like ploughing parallel to runoff and pulverize the farm which aggravates erosion. Inappropriate land use and farming practices primarily accelerate soil erosion (Walie, 2015). This study revealed although majority of farmers practiced appropriate agronomic practices that few farm households are still inappropriate agronomic practices while the.

4.5.11. Fearing reduction of land size due to land closure

Few (9.8%) respondents fear that implementation of closure practice reduce lands for other purposes and they rated this fear as this is high (46.2%) and moderate (53.9%) problem constraining implementation of WSM practice in the study area (Table 21). As per respondents that fear the closure reduce size of other land uses, ranked as 9th problem constraining implementation of WSM practice. KII and FGD discussants also indicated that some farmers refrain implementation of closure fearing that the practice reduces land for other uses like livestock grazing.

Currently, WSM practices following holistic approach to success sustainable natural resource management and utilization primarily for the purpose of farmers' livelihood improvement inhabited within watershed. However, in different parts of the country (Ethiopia) intended plan did not success due to lack of awareness, knowledge, training (capacity buildings), financial resources, appropriate linkage among stakeholders and institution and modern technologies and materials (Negasa, 2020).

4.6. Impacts of watershed management practices in the livelihood of farmers

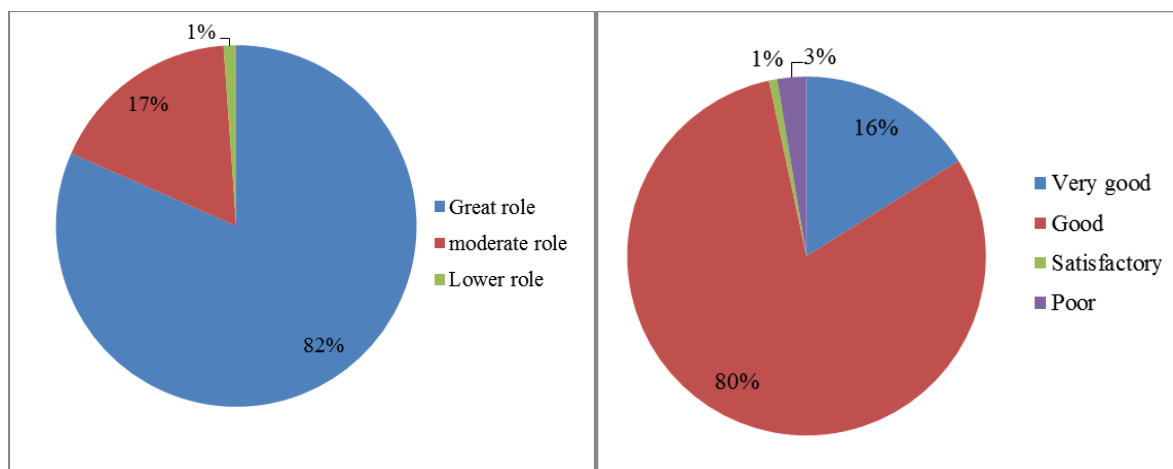
The study identified different role of WSM practices in terms of livelihood improvement of WSM that include: improving yield, benefits obtained from forest/trees products, creating job opportunity, improved watershed/hydrology, engagement in perennial crop production, and improved livelihood. Advantages gained from WSM are given in the following subsections.

4.6.1. Contribution of SWC practices in land productivity

The SWC activities improve the yield of smallholder farmers directly or indirectly. The analysis revealed that the SWC measures implemented on farmlands, grazing lands and non-farmlands played considerable role to enhanced yields and land productivity. Figure 8A showed that 82% respondents indicated that WSM practice has great role in improving yield and land productivity but 17% and 1% respondents rated the practices have moderate and lower role respectively. Similarly, FGD reported that the WSM particularly the physical SWC activities considerably improved crop yield by reducing runoff and thereby soil erosion.

Biological and agronomic measures are also likely significantly improving yields. Therefore, they have positive implication for improving household's income as they improve access to fodder and maintain soil fertility by reducing erosion, improving in-situ water availability. Additionally, KII SWC practices promoted crop yields due to its positive effect on moisture conservation in the soil for crop production. Therefore, from this it can be learned that the improved yield and production helps farmers to improve or maintain livelihood. Likely, improved soil fertility by compost and nutrient fixing plants is mostly suitable and used for cultivation to obtain more crop yields and positive improve farmers livelihoods (Kerse, 2017).

Figure 8B show farmers perception on yield difference from farmlands which and without SWC activities that revealed considerable difference. Accordingly, 80% respondents rated "good" yield from farmlands which SWC measures compared with farmlands without the practice the remaining 16%, 3% and 1% respondents rated the difference as "very good", "poor" and "satisfactory", respectively. In line to this, Kerse, (2017) affirmed after WSM conservation practices being undertaken, the farmers' food security improved due to increase in crop yields.



Graph A

Graph B

Sources: Own data survey (2021)

Figure 8: Contribution of SWC (graph A) in yields and comparing of yield after SWC implemented (graph B)

4.6.2. Benefits obtained from forest/tree products

The current analysis confirmed that smallholder farmers have been using output of forest from developed watershed to support their livelihood as reported by 56.4% respondents. These households indicated that they have been using forest/trees products from their land for lumber/timber production and other construction material. However, 43.6% households indicated that they are not using forest/trees for income generation to support the family's livelihood as such uses are restricted by government bodies (Table 22). Households reported that they have been using forest/trees product for firewood (93.2%) and charcoal (35.7%) production either for sell or home consumption. The survey respondents and FGD participants indicated that they are producing charcoal from dried/dead trees and other unusable trees and not from alive trees used for shade, agro-forestry, soil and water conserve and used for different purpose. Great majority sampled respondents indicated that they have been using forest/tree products produced in homestead and woodlot for the purpose of fencing (98.5%) and other construction purposes including housing (92.9%). Therefore, forest/tree preserved in watershed has been playing considerable effects to improve livelihood of smallholder farmers.

The economic growth of Ethiopia basically requires forest resources, as forest products are important for the industry, construction and energy generation. Moreover, forest is important for income generation like firewood, honey, forest coffees, fodder, gum, resin, and beeswax production, traditional medicine and as coffee shade and thereby improve farmers livelihood.

Although timber and charcoal extraction is not allowed, however, using lifeless plants/tees for timber and charcoal extraction is recommended so as to minimize deforestation and other alternative like introducing woodlot/plantation/ practices has encouraged (EFCCC, 2020; FAO, 2011).

Table 22: Forest/trees products used by survey HHs within watershed

Category	Yes		No	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Lumber/timber	150	56.4	116	43.6
Firewood	248	93.2	18	6.8
Charcoal	95	35.7	171	64.3
Fence	262	98.5	4	1.5
Construction	247	92.9	19	7.1

Sources: Own data survey (2021)

4.6.3. Watershed management as job opportunity

WSM practices used as job creation opportunities for landless and unemployed youths and smallholder farmers in rural Ethiopia. In this regard, youths and smallholder farmers organized in group or at family level to engage in different watershed management and output of WSM activities like irrigation, cattle fattening, beekeeping, tree seedling and wood production in watersheds so that individuals or households involved WSM able to support their livelihood. The different benefits that individual as well as organized youths and smallholder farmers obtained from watershed management practices in the study area are discussed under.

Animal/cattle fattening: Like other parts of rural Ethiopia, animal (cattle) fattening (sometimes production) is among rural job creation opportunity practiced using product (grass) watershed management practice by smallholder farmers or unemployed youths. Accordingly, in this analysis few (6.8%) survey HHs have been engaging in cattle fattening (rearing) organized in user group to uses the income to support their livelihood (Table 23). The statistical test revealed significant association ($X^2 = 3.4898$, $P = 0.06$) between cattle fattening based rural job creation using grass produced in developed watersheds. KII and FGD also ascertained that landless and unemployed rural youths and smallholder farmers engage in group based cattle fattening (production) using grass produced in developed watersheds.

Table 23: Watershed management for rural job creation

Types of job creation opportunity for survey HHs in the watersheds	HHs practiced in the activity				Does the practice contribute to improve the HHs livelihood			
	Yes		No		Yes		X ²	P-value
	count	%	count	%	count	%		
Animal/cattle fattening/rearing	18	6.8	248	93.2	18	100	3.4898	0.06
Beekeeping	20	7.5	246	92.5	20	100	6.86	0.009
Irrigation	75	28.2	191	71.8	74	100	45.44	0.000
Forest and forest products production	40	15	226	85	39	100	14.93	0.000
Tree seedling production	10	3.8	256	96.2	10	100	3.29	0.070

Source: Own data survey (2021).

Beekeeping: Beekeeping is among job creation opportunity to the rural landless and unemployed youths and smallholder farmers using output of developed watersheds either individual or group based approach. The youths/farmers engage in honey and/or bee colony production in the developed watersheds. Out of the sampled households, 7.5% reported that engaged beekeeping using bee forage produced in the developed watersheds and acknowledged that they are earning income from the activity to support their livelihood (Table 23). The statistical test showed significant association ($X^2 = 6.86$, $P = 0.009$) between job opportunity created by watershed management practices and beekeeping. KII and FGD result also showed that some farmers/youths engaged in group based beekeeping (honey production) using bee forage produced in developed watersheds. However, some group failed to continue the beekeeping due to disagreement, which is common problem for group based income generation activities in many areas in the country (Yenesew *et al.*, 2019). In relation to this, Bareke *et al.*, (2014) reported that integration of beekeeping with conservation and rehabilitation of natural resources could be significant motivation for communities to participate in natural resources conservation and rehabilitation program.

Engagement in irrigation practice: Irrigation is the crucial activities carried out in watershed to improve crop productivity. The household survey depicted that considerable proportion (28.2%) of survey respondents engaged in irrigation practices either in group or individual base, where they produces cereal crops mainly wheat and barley as well as vegetables like potato, tomato, green pepper, onion, cabbage and beetroot and carrot. The statistical test depicted significant association ($X^2 = 45.44$, $P = 0.000$) between job opportunity created due to watershed

management and irrigation practices. FGD discussants pointed that irrigation plays considerable role to improve income and livelihood of study community due to uses of watershed development interventions (Table 23).

KII and FGD revealed that farmers engaged in irrigation in watershed able to generate extra income and able to support their livelihood. The *Woreda* Agriculture and Natural Resource Office (2021) report showed that 278 individuals living in the woreda are organized in four groups and formed irrigation cooperatives and they have been producing perennial and annual crops. The irrigation activity helped the beneficiaries and their family to earn tangible income and improve the livelihood of farmers. These farmers able build improved house, insure food security and due to the additional income some are involving in other income generating activities like trading. FAO, (2010) reported that integration of irrigation and WSM practice intended to accelerate the economic growth of rural households.

Forest and forest products production: Table 23 provided engagement of study community in forest and its products production in developed watersheds for income generation. Regarding this some survey respondents (15%) reported that involved in group based forest and forest product production in developed watershed for the purpose of income generation. Households reported either the head or other family members (particularly youths in the families) engaged in forest and its products production through group based approach the activity helped the HHs to support their livelihood. The statistical analysis conducted to understand the role of the practices showed significant association ($X^2 = 14.93$, $P = 0.000$) between job opportunity created by watershed management through forest product production and employment or job creation. Hence, from this it can be learned well designed WSM can play important role to create job opportunity for smallholder farmers, and landless as well as unemployed youths so as to earn income and support their livelihood. The result of KII and FGD also the same with the above result. In this regard EFCCC (2020) report underlined the importance of afforestation and reforestation as part of watershed development help solve has unemployment problem as menses of job opportunity creation in rural areas.

Tree seedling production: Tree seedling production in group based nursery is also another job opportunity in watershed development in study area and other rural Ethiopia. Hence some (3.8%) survey respondents indicated that either the head or their family have been involving in tree

seedling production for income generation through supply to the community to plant as homestead, woodlot and protected areas in watershed under development (Table 23). Respondents practicing in tree seedling production through group based approach witnessed that the activity played significant role in supporting their livelihood. The statistical analysis also confirmed significant association ($X^2 = 3.29$, $P = 0.070$) between job creation by tree seedling production and developed watershed. The *Woreda* Agriculture and Natural Resource Office report (2021) and FGD results revealed that in the study area two nurseries groups were established and engaged in tree seedling for income generation. They indicated that the activity helped the individuals engaged in nursery (tree seedling production) activity to generate income and support their livelihood. Empirical study by Kerse, (2017) shows that WSM intervention significantly improved income of smallholder farmers in the means of honey production, vegetable and spices production; develop agro-forestry system integrating with fruit (like avocado, mango, coffee and orange) production as it generate surplus benefit and raise income diversification with employment opportunities.

4.6.4. WSM practices and its results in study area

In study analyzed anticipated changes due to WSM practices and it showed considerable implements as well as several visible and measurable changes. The sampled households mentioned that they gained tangible benefit in terms of environmental, socioeconomic and attitude after intervention in WSM practices (Table 24). The changes reported by almost all survey respondents include: increase in forest/tree/plantation cover, soil fertility, soil moisture , biodiversity like regeneration of denuded plant species and coming back of disappeared or escaped wild animals like fox, ape and rabbit. Moreover, all respondents (100%) acknowledged land productivity increased and households able to livelihood diversify and increase income due to WSM intervention. The FGD result also in line with the survey finding which affirmed that WSM intervention the above mentioned results. The FGD participants also added that the group based engagement in WSM helped the local communities to exchange knowhow, experience, promoted social relation and improved culture of working together, supporting each other and capacitated them to collectively solve own problem. The whole FGD discussants showed that WSM directly or indirectly contributed for improvement of smallholder farmer's livelihood. This finding has similarity with Gachene *et al.*, (2019) study which stated that, the main changes

observed after the implementation WSM practices include: reduced soil erosion, sedimentation and impact of runoff; increased soil moisture, land productivity, honey production, modern beekeeping practice, ground water recharge, stabilized gullies and river banks, rehabilitation of degraded lands, enhanced ecological balance. Similarly, Kerse, (2017) reported that integrated watershed management is effective in changing biophysical and socioeconomic aspects of targeted areas as well as bettering the condition of affected social group.

Table 24: Changes occurred after WSM implementation

Category	Yes	
	Frequency (N)	Percentage (%)
Increased forest covers	266	100
Increased soil fertility	266	100
Increased soil moisture and water availability	266	100
Increased biodiversity	266	100
Increased productivity	266	100
Increased livelihood diversification	266	100
Increased knowledge	266	100

Source: Own data survey (2021)

4.6.5. Perennial crop production and WSM practice

The analysis revealed that aside to WSM practices the long term crops production was implemented in the watersheds which was not common in the study area. Accordingly, the survey households indicated unlike the time before WSM practices they have been involving in perennial crop production. For example, the respondents planted mango (10.5%), avocado (9.4%), banana (3.8%), orange (10.9%), apple (8.3%), coffee (6.8%), lemon (2.3%), papaya (4.1%) and sugarcane (4.1%) for income generation and home consumption purpose hence support their livelihood (Table 25). Of the respondents those who practiced perennial crops production the great majority (92% - 100%) confirmed that the perennial crops they have been producing plays important role to improve income and livelihood of engaged households. FGD and KII results also showed that participation of households in perennial crops played important environmental role like improving the micro-climate, control soil erosion and add soil fertility. The perennial crops also significantly improved income and livelihood of smallholder farmers engaged in the crop production. This is similar with FAO, (2013) and Misebo, (2018) finding which indicated that integration of perennial crops production with WSM practice significantly

improved income and food security of participating households beside its role to the environment.

Table 25: Perennial crop and its role in livelihood support

category	Proportion respondent practiced				Proportion to support livelihood			
	Yes		No		Yes		No	
	Count	%	Count	%	Count	%	Count	%
Mango	28	10.5	238	89.5	26	92.9	2	7.1
Avocado	25	9.4	241	90.6	23	92	2	8
Banana	10	3.8	256	96.2	10	100	0	0
Orange	29	10.9	237	89.1	28	96.6	1	3.4
Apple	22	8.3	244	91.7	22	100	0	0
Coffee	18	6.8	248	93.2	18	100	0	0
Lemon	6	2.3	260	97.7	6	100	0	0
Sugarcane	11	4.1	255	95.9	11	100	0	0
Papaya	11	4.1	255	95.9	11	100	0	0

Source: own data survey (2021).

4.6.6. WSM and components of livelihood

The result of KII and FGD shows, WSM indeed help the farmers as to learn different skill from each other and it increased the skill and ability of labor. Furthermore, during the collaborative engagement in WSM and SWC activities farmers are sharing information and experiences. Therefore, the activities of WSM significantly increase the knowledge of community which is the component of livelihood. Similarly, Teka *et al.*, (2020) research found that the integrated WSM activities increased the knowledge of community on on natural resources management as well as soil and water conservation techniques and practices, improved agricultural practices, irrigation use and modern beekeeping practices.

Moreover, WSM practices significantly improve the natural capital like land, water, forest resources and biodiversity which is the main component of livelihood. The analysis result also revealed that, the WSM practices restored degraded resources as result dried water resources and loosed biodiversity rehabilitated. Integrated watershed management (IWSM) practices plays significant role to change biophysical resources (Kerse, 2017). In addition Kerse, (2017) noted that WSM practice encourage community network, create trustfully relationship among community and help to access social institution. WSM practices also supported to enhance

financial resources by diversifying income and created the opportunity of saving and credit services joint with created additional job opportunities.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Summary and conclusion

Currently, watershed management practices are key approach in natural resources conservation and rehabilitation particularly in degraded areas, which is true for Ethiopia. This study had deeply examined the practices of WSM implemented in study area. The practices identified by the study were physical measures like stone faced soil bunds, soil bunds, stone bunds, check dam, cutoff and drain (water ways). In addition, biological measures such as vegetation strip and planting along physical structure were practiced by local community through group and individual based approach. Moreover, study area communities have been implementing improved agronomic practicing like strip cropping, crop rotation and fallowing, retaining crop residue, contour ploughing, and planting agro-forestry trees on farmlands.

The study area communities have been also implementing WSM intervention on grazing land which include closure of grazing lands for restoration, uses of grass through cut and carry system, weeding of grazing lands to reduce non-palatable species and improve productivity as well as carrying capacity of the land, use rotational grazing and construction of physical SWC structures. Moreover, physical moisture retention structures mainly trenches, eye brow basins, micro-basins, hiring bones, half-moon and improved pits constructed on hilly area of individual and communal lands. Similarly, conservation measures such as forest tree plantation, physical SWC structures constructions and closure of degraded lands for self-restoration carried out on non-farmlands (hilly areas).

The analysis revealed that considerable improvement of natural recourses due to WSM through tree seedling production and planting, closure of degraded land, retaining indigenous trees, planting agro-forestry trees on farmlands in the study area. The study also showed that the WSM improved livestock production as the practices improved animal feed and grazing land management such as control grazing to reduce overstocking, unlike the older time farmers started stall livestock feeding by storing feeds mainly hay and crop residue, avoiding too early feeding of grazing land, application of rotational and cell grazing. The WSM and SWC practices

implemented in the study area helped to conserve wetlands, protected water source, conserving water for irrigation, control and harvest runoff water, protect water bodies (stream and ponds). The indigenous watershed management practices specified by this study was crop rotation, contour farming/ploughing, laying out farm drainage ditches and intercropping, construct bunds and terraces on farmland.

The factors constraining of the participation of smallholder farmers in watershed management practices identified by the study include: lack of training, provided trainings have had low quality, lack of appropriate technology, problems of open grazing, deforestation, destruction of constructed physical SWC structures, inadequate extension services, insufficient (small) farmland holdings, shortage of cash income to cover agricultural input costs, poor (backward) agricultural practices, farmers fear that physical SWC structures and closure reduce effective agricultural land size.

The results of study was elucidated that, WSM have great role in creating job opportunity in order to enhance income and livelihood of smallholder farmers. In the study area, the job opportunity created by WSM practices were irrigation, cattle fattening, beekeeping, forest and tree seedling production in in developed watershed, which directly or indirectly contributed for the improvement of the livelihood of farmers. In study area, the WSM practices implemented the environmental situation, socioeconomic and attitude of the community towards WSM. This study could be contributed to the descipiline that concerned to the finding and pave the ways for further study.

5.2. Recommendation

Although, the WSM practices implemented in study area has various achievements, it is very important to improve observed limitation. Therefore, local level implementers, policy makers and researchers need to consider the following recommendation so as to improve outcome and benefit of WSM practice in the study area and beyond. The study findings can be applied in area which similar setting with the study *woreda*. Depend on the finding of this study, the following recommendation had identified.

- ♣ Although physical WSM activities like stone faced soil bunds, soil bunds, stone bunds, check dam and cutoff drain were implemented in study area, most of the time these

structures constructed with limited technical knowhow and are labor and time intensive. Therefore, it is important to provide adequate technical training (to construct the physical structures) and considering indigenous knowledge of the community.

- ♣ Biological measures like grass/vegetation strips and planting physical SWC structures implemented by few (27.8% and 11.7%) households as reported. Therefore, there should be awareness raising and training on biological SWC measure particularly planting physical SWC structures to stabilize the structures and also use the structure for fodder plant which can be used through cut-and-carry system. In addition, farmers has to be advised to stop free grazing on lands with WSM so as to avoid destruction of constructed structure and grazing of structure stabilization plants.
- ♣ The study showed that due to small size of farmland holding only few farmers practice agronomic conservation activities. Thus, the farmers particularly those who have small size lands (farm and grazing) required action focused training which need to be support by experiment in order to enable the benefit (production/yields) from their respective small size of farmland and grazing land.
- ♣ The finding depicted that closure of grazing land for restoration (34.2%) and construction of physical SWC technologies (13.9%) were too small comparing with other integrated WSC practices in the study area. Therefore, there should be more promotion and extension work to improve implementation of the measures both through individual and group based approach.
- ♣ Since the physical moisture retention structures have important role in soil and water trapping, it should be implemented in all hilly areas be owned by individuals farmers or communally. Therefore, actors need to provide material (e.g., farm tools) support to enhance implementation of the practice by mobilizing resources from government and NGOs like SLM, CALM, AGP and other.
- ♣ Although study area community engaged tree seedling planting in homestead, woodlots and on farmlands as agro-forestry and encroachment tree planting in closure still some farmers engaged in illegal tree cutting. Therefore, there should be awareness creation and training to reduce illegal tree cutting.
- ♣ The study identified different problems related with participation and practices in WSM practice due to awareness problem, lack of training, low quality trainings, lack of

appropriate technology, inadequate extension services, small farmland holdings, shortage of cash to cover agricultural input, backward agricultural practices and the fear that SWC structure and closure reduce farmland size. Therefore, even though it is difficult to solve all problems in short time, development actors and policy maker shall give emphasis on these issues to solve the limitations through providing action oriented trainings, awareness creation and providing input.

- ♠ The WSM has been creating different job and income generation opportunity like cattle fattening, tree seedling production and beekeeping through individual and group based approach. However, the group based income generation enterprises have been challenged by disagreement among members. Therefore, it is vital to tack care while organizing members in group and assist them to establish strong bylaw and obey the bylaw.

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Annex 1: Survey Questionnaire for Sample HH

Dear respondent!

I would like to thank for your willingness to response in this survey. This survey is conducted for purposes of Dagne Ababu's postgraduate student who has been studying in Addis Ababa University, College of Development Studies and Center for Environment and Sustainable Development. Currently, Dagne is doing his thesis that entitled Watershed Management Practice and Livelihood of Smallholder Farmers Evidence from Hidabu Abote Woreda. Therefore, this questionnaire is aimed at collecting data concerning watershed management practices and livelihood of farmers. Hence, your response has key value for the study, thus you're genuine and reliable information on the topic will help for the above specified purpose (MA thesis) and also might have contribution for future policy making and generate knowledge. On this occasion, would like to declare that your household is selected randomly from the HH of the kebele. I also like to affirm that the interview result will exclusively use for the purpose I mentioned above and the data will kept confidential at all-time even after analysis. Indeed, please be free from any stress and doubt to describe or explain your ideas, knowledge and experience in watershed management. This interview will take forty minute of your time. Therefore, be patient until we accomplish the question.

Date of interview _____	DD/MM/YY
Name of Interviewer _____	Household ID. _____
Supervisor name _____	
Woreda _____,	Kebele _____,
Village _____	
Agro ecology _____	

Thank you for your cooperation!

PART I: Demographic Characteristics of the Respondent

1. Sex of respondent 1= Male 2= Female
2. Headship of the responding household 1) Male headed 2) Female headed
3. Age of household head (in years) _____ years

10.5	Calves	
10.6	Donkey	
10.7	Goat	
10.8	Sheep	
10.9	Horse	
10.10	Mule	
10.11	Poultry	
10.12	Bee hives	
10.13	Others if exist	
Total		

11. Do you access to land (farm, grazing, woodlot)? 1=Yes 0=No

12. If your answer is 'yes' in Q11, by what way you get farmland? 1)gift 2)Inherited 3) redistribution (government) 4) adjudication/decision

13. What is the size of land you owned in hectare?

No	Land use type	Area (Ha)
13.1	Cultivate land	
13.2	Grazing land	
13.3	Homestead	
13.4	Plantation/woodlot	
13.4	Others	
Total		

14. What is the major crop type do you produce in 2012/13 *Meher* production year?

	Crop type	Area (ha)	Do used fertilizer? (0= No, 1= Yes)
I	Cereals		
13.1	Wheat		
13.2	Barely		
13.3	Teff		
13.4	Sorghum/millet		
13.5	Maize		
II	Legume		
13.6	Pea		
13.7	Horse bean		
13.8	Check pea		
13.9	Lentil		
III	Pulses		
13.10	Flax (telba)		
13.11	Niger seed (noug)		
13.12	Sesame		
13.13	Peanut		

13.14	Sunflower		
13.15	Other		

15. In your perception how do you rate the fertility status of your farmland? 1)Very good
2)Good 3)Poor 4)Very poor

16. Do you access to irrigation practice? 0) No 1) Yes

17. If your answer is 'yes' on Q16, for what you practiced?

No	Types of crop and vegetable	0) No, 1) Yes
17.1	Wheat	
17.2	Barley	
17.3	Maize	
17.4	Onion	
17.5	Green pepper	
17.6	Potato	
17.7	Tomato	
17.8	Cabbages	
17.9	Red root and carrot	
17.10	Other	

18. As per your evaluation, how do you rate the average yield you obtain from your pilot of agricultural lands? 1)=Very low 2)Low 3)Medium 4)High 5)Very high

19. Do you applying agricultural input on your farmlands? 0= No 1= Yes

20. If 'yes' to Q19 which input you have been using?

Input type	0= No 1) Yes	If yes, reason for the use,			
		1	2	3	4
20.1. Chemical fertilizer					
20.2. Improved seed					
20.3. Herbicide and pesticide					

Note: 1) improve fertility and thereby yield, 2) improve productivity
3) Better adaptability 4) control pest and disease

PART III: What are WSM practices implemented in study area? (Specific objective one)

21. Do you participate in watershed management activities? 0=No 1=Yes
22. If your response is 'yes' in Q21, for how many years you participate? _____ years
23. How was your participation in watershed management?
 1) Individual base, 2) in group base 3) both group and individual base
24. Do you practice the activities of soil and water conservation (SWC) and WSM on your own (individual) farmland and grazing lands? 0=No 1=Yes
25. If your response is 'yes' in Q24, what types of practices do on your pilot of farmland?

	WSM activities	0= No, 1= Yes	From the practice, do it helped to increases yield? 0= No, 1=Yes
	On farmland		
I	Physical measures		
25.1.1	Soil/stone faced bunds		
25.1.2	Soil bund		
25.1.3	Stone bund		
25.1.4	Check dam		
25.1.5	Cut of drain, water way		
II	Biological measures		
25.2.1	Grass/vegetation strip		
25.2.2	Planting of physical structure stabilizing plants along structures		
III	Agronomic/management measures		
25.3.1	Strip cropping		
25.3.2	Fallowing		
25.3.3	Retaining crop residue on farmlands		
25.3.4	Contour ploughing		
25.3.5	Planting Agro-forestry on farmlands		
25.3.6	Crop rotation		
	On Grazing land		
25.4.1	Closure of grazing land for restoration		
25.4.2	Use cut and carry system of grass		
25.4.3	Grazing/grass land weeding to reduce non-palatable species		
25.4.4	Use of rotational grazing		

	WSM activities	0= No, 1= Yes	From the practice, do it helped to increases yield? 0= No, 1=Yes
25.4.5	Construction of physical SWC structures (hillside terrace, micro basin, check dam, trench, improved pit, eye brow, herring bone)		
	Non-farmland		
25.5.1	Forest tree plantation		
25.5.2	Construction of physical SWC structures (hillside terrace, micro basin, check dam, trench, improved pit, eye brow, herring bone)		
25.5.3	Closure of land for self-restoration		

26. In your view, do implementation of WSM practices on farmland changed your income/yield? 1=Yes 0=No

27. If your answer is 'yes' on Q26, which types of WSM activities applicable for increasing of income/yield/? 1) physical soil and water conservation activities 2)agro forestry 3) agronomic (manage farming like minimum tillage and green manure) methods 4) all 5)other

28. Is there any difference of yields between farmland with WSM practiced and non-practiced? 1=Yes 0=No

29. If your response is 'yes' on Q28, do you rate its importance?

No	WSM activities	Importance of WSM practices
		1=Low, 2=Moderate, 3=High
29.1	Physical SWC measures	
29.2	Biological measurements	
29.3	Agronomic practices	

30. By what ways or methods do you conserve the available forest in watershed on your lands (any type of land the household has)?

No	Forest conservation method	0=No 1=Yes	For what it used?					
			1	2	3	4	5	6
30.1	Seedling plants							
30.2	closure of degraded land for trees to come up							
30.3	Preserve (avoid cutting) indigenous trees							
30.4	Planting of agroforestry trees on farmlands							
30.5	Other							

Note: 1) Stabilize local climate, 2) Used for recreation, 3) Control soil erosion, 4) Keep soil moisture, 5) Used as cattle feed, 6) Timber 7) other benefit

31. Do you practice livestock feed and grazing land management? 0= No 1=Yes

32. If yes on Q31, how do you have been managing livestock feed and grazing lands?

No	Activities to control overgrazing	0=No 1=Yes	If yes, please rate its role to minimize overgrazing; 1=low, 2=moderate, 3=high
32.1	Control overstocking		
32.2	Feed livestock by storing feed like hay and crop residue (Geleba)		
32.3	Avoid too early grazing of grazing lands (kelo)		
32.4	Using rotational/mob and cell grazing		
32.5	Planting of improved fodder types (such as elephant grass, adadi, vetivar, sesbania sesban, alfalfa, clover, bana grass, roads grass) and feed the livestock		

33. Do you practice water resources management activities on your private and/or communal lands? 0= No 1= Yes,

34. If you apply water resources management practices on your private and communal lands, how you conserve and protect water resources?

No	Activities of water protect	0=No, 1=Yes
34.1	Protect wetland	
34.2	Protect sources of water (spring, well) by applying different management practice like fencing, diverting flash flood...	
34.3	Save water during irrigation	
34.4	Control run off	
34.5	Harvesting rain water	
34.6	Protect stream and pond/lake by managing the sides	

35. Is there any traditional WSM practiced in your area before introduction of the practice modern WSM by government and/or NGO? 0= no 1= yes

36. If the traditional WSM practice existed which practices being implemented?

No	Activities of traditional WSM	0=No, 1=Yes
36.1	Crop rotation	
36.2	Contour farming/ploughing	
36.3	Farm drainage ditches (boyi) making	
36.4	Intercropping (mixed cropping) e.g., wheat and barley/wasera	
36.5	Constructing bunds (terraces)	
36.6	Use of guy (ጋፆ)	
36.7	Other (specify)	

PART IV. Factors constraining watershed management practices (Specific objective two)

37. What are the major constraints of WSM practice?

No	Factors constraints	0) No, 1)Yes	Level of constraints 1=Low, 2=Medium, 3=High
37.1	Limited capacity building/training (Knowledge)		
37.2	Low quality (lack of practical sessions, capacity of trainers ...) and inadequate (time shortage, cover small number of farmers, lack of refreshment and updating...) capacity building trainings given at FTCs		
37.3	Lack of access to appropriate technology		
37.4	Problem of open grazing		
37.5	Deforestation		
37.6	Distraction of constructed SWC structures		

37.7	Lack of adopting bylaw for natural resources mangment and conservation		
37.8	Inadequate extension services		
37.9	Insufficient (small) farmland holding		
37.10	Shortage of cash income to cover agricultural input		
37.11	Poor (backward) agricultural practices		
37.12	Fearing reduction of farmland size due to land closure		
37.13	Others		

**PART V. Role of watershed management practices in livelihood of smallholder farmers
(specific objective three)**

38. On your perception, what do you think about contribution of SWC practices in income generate? 1=it has great role 2=it has moderate role 3=it has low role

39. What types of forest product produced within the watershed?

No	Forest product	0=No,1=Yes
39.1	Lumber/timber	
39.2	Firewood	
39.3	Charcoal	
39.4	Fence	
39.5	Use for construction	
39.6	Others if exist	

40. How do you compare the yield obtained from your farm pilot after SWC activities carry out?
1=very good 2=good 3=satisfactory 4=poor

41. Do you use extract and sale grass from communal land/watershed/? 0=No 1=Yes

42. Do WSM practices create job opportunity for your household? 1=Yes 0=No

43. If 'yes' on Q42, what types of job opportunity?

No	Job opportunity	0=No, 1=Yes	Do these practices contribute to income and livelihood? 0=No, 1=Yes
43.1	Rearing cattle		
43.2	Hive bees		
43.3	Practice irrigation		
43.4	Organizing unemployment by cooperation/association on keep forest, irrigation and other		
43.5	Tree seedling and plantation activities		
43.6	Other(specify)		

44. Is there any change on environment, socioeconomic and personal attitude before and after WSM practices implemented? 1=Yes 0=No

45. If your answer is 'yes' on Q44, what has changed after WSM activities done in the area?

No	Types of changed	0) No 1)Yes
45.1	Increased forest covers	
45.2	Increased soil fertility	
45.3	Increased soil moisture and water availability	
45.4	Increased biodiversity	
45.5	Increased productivity	
45.6	Increased livelihood diversification	
45.7	Increased knowledge	
45.8	Other	

46. Do you practice perennial crop production in developed watershed? 0) No, 1) yes

47. If yes to Q46, which perennial crop you have been producing?

	Types of perennial crops	0) No, 1) yes	Do it support you livelihood? 0) no, 1) yes
49.1	mango		
49.2	Avocado		
49.3	Banana		
49.4	Orange		
49.5	Apple		
49.6	Coffee		
49.7	Currant		
49.8	Fennel		
49.9	Grape		
49.10	Lemon		
49.11	Peaches		
49.12	Pineapple		
49.13	Papaya		
49.14	Sugar		

48. For what livelihood components WSM practices contribute?

No	Livelihood components	0) No 1) Yes
48.1	Human capital	Skill/ability to labor
		knowledge
		Health services
48.2	Natural capital	Land
		water
		Biodiversity and wildlife
48.3	Social capital	Community network
		Membership of group
		Relationship of trust

		Access to social institution	
48.4	Financial capital	Saving and credit	
		Regular remittances	
48.5	Physical capital	transport	
		shelter	
		energy	
		communication	

Thank you for your advance cooperation!

Annex 2: Checklists for FGD

Dears!

I would like to say thank you for your willingness to response what I am going to ask you.

My name is Dagne Ababu. I am a postgraduate student at Addis Ababa University, College of Development Studies and Center for Environment and Sustainable Development. Currently I am doing my thesis that entitled Watershed Management Practice and Livelihood of Smallholder Farmers Evidence from Hidabu Abote Woreda. By this FGD, I want collect data concerning watershed management practices and livelihood of farmers. Hence, your idea has key value for my study and I hope that to gain reliable information about my topic in your locality or village which is indispensable for future policy making and generate knowledge. You are selected from the HH of the kebele. Perhaps, if you agree to participate in this FGD there is no any return. Indeed, please be free from any stress and doubt to describe or explain your ideas, knowledge and experience in watershed management. This FGD will take 1:30 an hour of your time. Therefore, be patient until we accomplish the question.

Date of Discussion _____ DD/MM/YY

Name of coordinator _____
Supervisor name _____
Woreda _____, Kebele _____,
Village _____

Thank you for your cooperation!

1. Do you implement WSM and SWC practices in your area?
2. What types of WSM practices implemented in your village in previous time?
3. What is the benefit of WSM practice?
4. Is there any traditional soil and water conservation practice before the current interventions? if exist what type? What role they have?
5. Does the community practice modern SWC and WSM in your village? Which type of SWC and WSM practices and on which land ownership communal/individual land?
6. Explain factors that challenge the participation of the local community in SWC and WSM?
7. Explain the advantage of WSM practices? What job opportunities created?
8. What are the contribution of WSM in income generation and livelihood of farmers?
9. Do you compare the yields you obtain before and after WSM practice implemented? How you rate it? Do yield changed due to SWC and WSM?
10. What is the perception of smallholder farmers about WSM?
11. How evaluate the government/extension system commitment in WSM activities?
12. What do you think that, the role of culture in WSM and forest /tree/ conservation?

Annex 3: Checklist for KII

Dear/s!

I would like to say thank you for your willingness to response what I am going to ask you.

My name is Dagne Ababu. I am a postgraduate student at Addis Ababa University, College of Development Studies and Center for Environment and Sustainable Development. Currently I am doing my thesis that entitled Watershed Management Practice and Livelihood of Smallholder Farmers Evidence from Hidabu Abote Woreda. By this interview, I want collect data concerning watershed management practices and livelihood of farmers. Hence, your response has key value for my study and I hope that to gain reliable information about my topic in your locality or village which is indispensable for future policy making and generate knowledge. You are selected from the HH of the kebele. Perhaps, if you agree to participate in this study as interviewee there is no any return. Indeed, please be free from any stress and doubt to describe or explain your ideas, knowledge and experience in watershed management. This interview will take forty minute of your time. Therefore, be patient until we accomplish the question.

Date of interview _____ DD/MM/YY
Name of Interviewer _____
Supervisor name _____
Woreda _____, Kebele _____,
Village _____

Thank you for your cooperation!

1. Do you practice WSM in your area? _____

2. What types of WSM and SWC measurement you carry out in your village /area? _____

3. What is the benefit of WSM activities? _____

4. What kinds of traditional WSM practices implemented in farm land, grazing land and woodlot? _____

5. What are the modern WSM practiced in communal land and individual land?_____

6. What is main constraints faced in the participation of WSM and SWC activities?_____

7. Do you think that, WSM have advantage contribute farmers' livelihood? How? What job opportunities created

8. What are the contributions of WSM activities in job creation, income generation, farmers' livelihood?
How?_____

9. Is there any differences between the livelihood of farmers inhabited in WSM practiced and non-practiced? Why? Do you compare and rate in %_____

10. What is your attitude toward WSM practices?_____

11. How you evaluate the contribution of government in the activities of WSM_____

12. Explain the role of culture in WSM and forest/tree conservation? _____

Thank you for your advance cooperation!

Annex 4: Af-gaaffii Afaan Oromiffaa

Guyyaa gaafannoo _____
Maqaa Nama Gaafatuu _____ koodii matii _____
Maqaa To'ataa _____
Aanaa _____, Ganda _____,
Gooxii _____
Haala teessuma lafaa _____

Waan nu deeggartaniif galatoomaa!

Kutaa I: Odeeffannoo deebii kennaa

- Saala 1= Dhiira 2= Dhalaa
- Haala geggeessaa maatii 1) dhiira 2) dhalaa
- Umrii deebi-kennaa (waggaadhaan) _____
- Haala fuudha fi heerumaa: 1=kophaa kan jiraatu/ttu 2=kan fudhe/heerumte 3=kan hike/te 4=kan abbaan manaa/haati manaa du'e/duute 5=kan haadha manaa baay'ee qabu
- Sadarkaa Barnoota geggeessaa maatii:
 - Kan hin baranne 4) kutaa 5-8
 - kan dubbisuu fi barreessuu (informal education) 5) kutaa 9-12
 - kutaa 1-4 6) Dippiloomaa fi isaa ol

6. Baay'ina maatii:

	umrii	dhiira	dhalaa	Ida'ama	yaada
6.1	<15				
6.2	16-64				
6.3	>65				
6.4	Ida'ama				

Kutaa II: Haala Hawaas-dinagdee deebii kennaa

7. Maddi galii keetii maalii?

lakk	Madda galii fi haala jiruufi jireenyaa(livelihood)	0= lakki 1= eeyyee	Galii biriidhaan
7.1	Daldala xixiqqaa		
7.2	Hojii Humnaa/guyyaa		
7.3	Hojii ogummaa (ijaarsa, hojii mukaa, sibiila tumuu, hojii supheefi uffata dhawuu)		
7.4	Seeftineetii/deeggarsa adda addaa		

7.5	Mindeeffamaa/mindaadhaan kan jiraatu		
7.6	Deeggarsa maatii fi kan biraa/remittance		
7.7	Kan biraa		
Ida'ama			

8. Yeroo ammaa kana gosa hojiilee qonnaa(farm activities) akkamii hordofaa jirta? 1) oomisha midhaanii qofa 2) oomisha horii qofa 3) oomisha wal makaa (oomisha midhaanii fi horii)
9. Horii qabdaa? 1=eeyyee 0=lakkii
10. G9^{ffaa} irratti eeyyee yoo jette, kan armaan gadii keessaa adda baasi;

lakk	Gosa horii	Baay'ina horii
10.1	Qotiyoo/kormaa fi sangaa	
10.2	Dullattii fi goromsa	
10.3	jabbi	
10.4	harree	
10.5	Re'ee	
10.6	hoolaa	
10.7	farda	
10.8	gaangee	
10.9	lukkuu	
10.10	Gaagura/kanniisa	
10.11	Kan biroo	
Ida'ama		

11. Lafa qabdaa? (qonnaa, dheedumsaa, bosonaa/biqiltuu)? 1=eeyyee 0=lakkii
12. G11^{ffaa} irratti eeyyee yoo jette, haala kamiin lafa qonnaa kana argatte? 1)kennaa 2)Dhaaltummaa 3) hirmaata mootummaadhaan 4) murtiidhaan
13. Bal'inni lafa qabatee jirtuu hagam ni ta'aa?

lakk	Gosa itti fayyadama lafaa	Bal'ina hektaaran
13.1	Lafa qotiisaa	
13.2	Lafa dheedichaa	
13.3	Oddoo/ijaarsa/	
13.4	Lafa bosanaa/biqiltuu/(plantation)	
13.4	Kan biraa	
Ida'ama		

14. Bara 2012/13 keessa gosa midhaan kam baay'inaan oomishtee?

	Gosa midhaanii	Bal'ina	Xaa'oo ni fayyadamtee? (0= lakkii,
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		lafaa/hektaaraan	1= eeyyee)
I	Midhaan calla/Cereals/		
13.1	Qamadii		
13.2	garbuu		
13.3	xaafii		
13.4	mishingaa		
13.5	boqqoolloo		
II	Midhaan dheedhii/legumes		
13.6	Atara		
13.7	baaqelaa		
13.8	shumburaa		
13.9	missira		
III	Midhaan zayitaa		
13.10	Talbaa		
13.11	nuugii		
13.12	Saliixa		
13.13	ocholonii		
13.14	Suufii		
13.15	Kan biraa		
Ida'ama			

15. Akka yaada keetti, gabbinni biyyoo maasii keetii maal fakkata? 1)baay'ee gaariidha 2)gaariidha 3)xiqoodha 4)baa'ee xiqqaadha
16. Haalota jallisiif barbaachisan ni argattaa? 0) lakkii 1) eeyyee
17. G16^{ffaa} irratti eeyyee yoo jette, midhaanii fi ashaakiltoota kamiif jallisii fayyadamta?

No	Gosa midhaanii/ashaakiltii	0) lakkii, 1) eeyyee
17.1	Qamadii	
17.2	Garbuu	
17.3	Boqqoolloo	
17.4	Shunkurtii	
17.5	Qaaraa	
17.6	Dinnicha	
17.7	Timaatima	
17.8	Goommana	
17.9	Hundee diimaa fi kaarotii	

17.10	Kan biraa	
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18. Akka madaallii keetti, callaan lafa qonnaa kee irraa argattu maal fakkaata? 1)=baay'ee xiqqaa dha 2)xiqqaadha 3)giddu galeessa 4)olaanaadha 5)baa'ee olaanaadha
19. Lafa qonnaa kee irratti naqa qonnaa (agricultural input) ni fayyadamtaa? 0= lakkii 1=eeyyee
20. G19^{ffaa} irratti eeyyee yoo jette, naqa qonnaa kam fayyadamaa jirtaa?

Gosa Naqaa (Input type)	0= lakkii 1) eeyyee	Yoo eeyyee jette, maalif itti fayyadamta?			
		1	2	3	4
20.1. Xaa'oo					
20.2. Sanyii fooyya'aa					
20.3. Farra aramaa fi ilbiisotaa (Herbicide and pesticide)					

- Hubadhu: 1) gabbina biyyoo gargaaruuf 2) callaa argamu dabaluuuf
3) Walbariinsa gaarii uumuuf (Better adaptability 4) maxxantoota fi dhukkuba adda addaa to'achuuf (control pest and disease)

Kutaa III: Hojiileen misooma sululaa iddoo kanatti hojii irra oolaa jiru maal faadhaa?

21. Hojiilee misooma sululaa keessatti ni hirmaattuu? 0=lakkii 1=eeyyee
22. G21 irratti eeyyee yoo jettan, waggaa meeqaaf hirmaattan? _____
23. Haala kamiin hojiilee misooma sululaa hirmaachaa turtanii?
1) dhuunfaadhaan, 2) gareedhaan 3) karaa lamaanuu
24. Hojiilee kunuunsa eegumsa biyyoo fi bishaanii maasaa dhuunfaa keessanii irratti ni hojjettuu? 0=lakkii 1=eeyyee
25. G24^{ffaa} irratti eeyyee yoo jettan, hojiilee akkamii maasii keessan irratti hojjettuu?

	Hojiilee misooma sululaa	0= lakkii, 1=eeyyee	Hojiileen kunneen callaa/oomisha guddisuuf ni gargaaru? 0= lakkii, 1=eeyyee
	Lafa qonnaa irratti		
I	Hojiilee fiizikaalaa		
25.1.1	Daagaa biyyoo/dhagaa		
25.1.2	Daagaa biyyoo		
25.1.3	Daagaa dhagaa		
25.1.4	Hidha hojjechuu/Check dam		

	Hojiilee misooma sululaa	0= lakkii, 1= eeyyee	Hojiileen kunneen callaa/oomisha guddisuuf ni gargaaruu? 0= lakkii, 1=eeyyee
25.1.5	Boraatii fi daandii lolaa hojjechuu/Cut of drain, water way		
II	Hojiilee baayoolojikaalaa		
25.2.1	Margaa fi biqiltuu walkeessa dhaabuu/ Grass/vegetation strip		
25.2.2	Istraakcharoota jiidha qusatan irra biqiltuu dhaabuu/Planting of physical structure stabilizing plants along structures		
III	Haala qotiisaa/Agronomic/management measures		
25.3.1	Midhaan walmakanii facaasuu/Strip cropping		
25.3.2	Lafa baasuu/Fallowing		
25.3.3	Haftee midhaanii maasaa irratti dhiisuu		
25.3.4	Sararaan qotuu		
25.3.5	Agro forestry lafa qonnaa irratti fayyadamuu		
25.3.6	Dabareedhaan midhaan facaasuu		
	Lafa dheedichaa irratti		
25.4.1	Lafti akka muuxatu irraa dhoowwuu/Closure of grazing land for restoration		
25.4.2	Mala haamanii nyaachisuu fayyadamuu/Use cut and carry system of grass		
25.4.3	Marga hin nyaatamne balleessuuf lafa margaa aramuu/Grazing/grass land weeding to reduce non-palatable species		
25.4.4	Dabareedhaan dheechisuu		
25.4.5	Straakcharoota jiidha qusatan hojjechuu/Construction of physical SWC structures (hillside terrace, micro basin, check dam, trench, improved pit, eye brow, herring bone)		
	Lafa qonnaa kan hin taane irratti		
25.5.1	Biqiltoota bosonaa dhaabuu		
25.5.2	Straakcharoota jiidha qusatan hojjechuu/Construction of physical SWC structures (hillside terrace, micro basin, check dam, trench, improved pit, eye brow, herring bone)		
25.5.3	Lafti akka of haressu gochuu		

26. Akka yaada keetti, hojiilee kunuunsa eegumsa biyyoo fi bishaanii yoo lafa qonnaa irratti hojiirra oolchine jijjiiramni galii fi oomishaa ni dhufaa? 1=eeyyee 0=lakkii
27. G26^{ffaa} irratti yoo eeyyee jette, hojiilee misooma sululaa keessaa kamtu omishaaf/galii argachuuf gargaara? 1) hojiilee fiizikaalaa kunuunsa biyyoo fi bishaanii hojjechuu 2)hojii qonnaa fi lafa qonnaa keessa biqiltuu dhaabuu (agro forestry) 3) mala qonnaa sirreessuu (manage farming like minimum tillage and green manure) 4) hunda 5)kan biraa,

28. Oomishni lafa qonnaa hojiileen misooma sululaa irratti hojjetamee fi hin hojjetamne garaagarummaa qabaa? 1=eeyyee 0=lakkii

29. G28^{ffaa} irratti eeyyee yoo jette, barbaachisummaa isaa sadarkeessi?

lakk	Hojiilee misooma sululaa	Barbaachisummaa hojiilee mi/sululaa
		1=gadaanaa, 2=giddugaleessa, 3=olaanaa
29.1	Hojiilee eegumsa biyyoo fi bishaanii/physical SWC measures	
29.2	Hojiilee baayoo fiizikaalaa/biological measurements	
29.3	Hojiilee qonnaa/agronomic practices	

30. Mala ykn haala kamiin bosona/ biqiltoota sulula (maasiikee) keessa jiru kunuunsita/eegdaa?

Lakk	Mala kunuunsa bosona/biqiltoota	0=lakk 1=eeyyee	Faayidaa kamiif?					
			1	2	3	4	5	6
30.1	biqiltuu dhaabuudhaan							
30.2	Lafa dhiqame biqiltootaaf dhorkuudhaan							
30.3	Mukkeen biyya keessaa eegu/tursiisuu/ fi muruu dhiisuu							
30.4	Qonnaa fi mukkeen wal makuu/agroforestry/							
30.5	Kan biraa							

Hubadhu: 1) haala qilleensa naannoo tasgabbeessuuf, 2) bashannanaaf oolchuu, 3) dhiqama biyyoo hirrisuuf, 4) jiidhinsa biyyoo eeguuf, 5) nyaata horiitiif oochuuf, 6) xaawulaa oomishuuf

31. Hojiilee eegumsa/bulchiinsa/ nyaata horii fi lafa dheedichaa ni taasitaa? 0= lakkii 1=eeyyee

32. G31^{ffaa} irratti yoo eeyyee jette, akkamitti nyaata horii fi lafa dheedichaa bulchita/eegda?

lakk	Hojiilee qoqorama lafaa to'achuu	0=lakkii 1=eeyyee	Yoo eeyyee, jette ga'ee lafa qoqorsiisuu xiqqeessuu sadarkeessi 1=gadaanaa,

			2=g/galeessa, 3= olaanaa
32.1	Baay'na horii xiqqeessuu		
32.2	Okaa fi galabaa nyaachisuu		
32.3	Kaloo dafanii dheechisuu dhiisuu		
32.4	Dabareedhaan dheechisuu		
32.5	Sanyii margaa fooyya'aa fayyadamuu (elephant grass, adadi, vetivar, sesbania sesban, alfalfa, clover, bana grass, roads grass)		

33. Lafa dhuunfaa fi lafa waliinii irratti hojiilee kunuunsa (qabiinsa/bulchiinsa) qabeenya bishaanii ni hojjettaa? 0= lakkii 1= eeyyee
34. G33^{ffaa} irratti eeyyee yoo jette, akkamitti eegumsa fi kunuunsa qabeenya bishaanii kana raawwatta?

lakk	Hojiilee kunuunsa bishaanii	0=lakkii, 1=eeyyee
34.1	Lafa bishaanii(wetland) kunuunsuu	
34.2	Qabeenya bishaanii kanneen akka burqaa, boolla bishaanii fi kkf kunuunsuu,dallaa itti ijaaru, booyii irraa baasuu	
34.3	Yeroo jallisii fayyadamnu bishaan qusachuu	
34.4	Bishaan yaa'u to'achuu/contro runoff	
34.5	Bishaan walitti qabuu	
34.6	Laggeen, haroo, boolla bishaanii eeguu (naannoo isaa eeguudhaan)	

35. Utuu malli kunuunsa biyyoo fi bishaanii kan ammayyaa karaa mootummaa fi mit-mootummaatiin hin jalqabamin dura karaa aadaatiin ni hojjetama turee?

0= lakkii 1= eeyyee

36. Yoo malli aadaa kun jira ta'e isa kami?

No	Hojii aadaa kunuunsa misooma sululaa	0=lakkii, 1=eeyyee
36.1	Dabareedhaan midhaan facaasuu	
36.2	Sararaan qotuu/facaasuu	
36.3	Lafa qonnaatti booyii baasuu	
36.4	Midhaan walitti makanii facaasuu	
36.5	Daagaa adda adda hojjechuu	
36.6	Gaayii gubuu	
36.7	Kan biraa	

kutaa IV. Factors constraining watershed management practices (Specific objective two)

37. Rakkoon gurguddoo hojii misooma sululaa maali?

lakk	Sababa rakkoolee	0) lakkii, 1)eeyyee	Sadarkaa rakkoolee 1=gadaanaa,2=g/gale essa,3=olaana
37.1	Rakkoo/hanqina/ leenjii adda addaa fi beekumsaa		
37.2	Hanqina qulqullina leenjii (hanqina shaakalaa, dandeettii leenjisa xiqqoo ta'uu) fi sa'atii xiqqoo keessatti qonnaan bulaa muraasaf FTCtti leenjii kennuu fi kkf		
37.3	Rakkoo/hanqina/ teknoolojii mijataa		
37.4	Rakkoo horii gadi lakkisuu		
37.5	Cirama bosonaa		
37.6	Istraakcharoota hojjetame diiguu		
37.7	Rakkoo hawaasni seera ittiin qabeenya uumama to'atan baafachuu dhabuu		
37.8	Eksteenshiniin gahaa ta'e dhabamuu		
37.9	Lafa qonnaa gahaa dhabuu		
37.10	Hanqina galii qarshiidhaan		
37.11	Mala qonnaa hin malle fayyadamuu		
37.12	Lafni qonnaa ni dhiphata jedhanii sodaachuu(yoo lafti tuttuqaa irraa dhorkame)		
37.13	Kan biraa		

Kataa V. Role of watershed management practices in livelihood of smallholder farmers

38. Akka yaada keetti, galii argachuuf gaheen hojii kunuunsa biyyoo fi bishaanii maali?
1=gahee olaanaa qaba 2=gahee g/galeessaa qaba 3=gahee gadaanaa qaba

39. Sulula keessatti bu'aaleen bosona irraa argaman maalii?

Lakk	Bu'aalee bosonaa/biqiltoota	0=lakkii,1=eeyyee
39.1	Xaawulaa baasuu	
39.2	Qoraan	
39.3	Kasala/cilee	
39.4	Dallaaf	
39.5	Ijaarsaaf	
39.6	Kan biro	

40. Oomisha lafa qonnaa kee irraa argamu erga hojiin kunuunsa eegumsa biyyoo fi bishaanii irratti hojjetmee akkamitti madaaltuu? 1=baay'ee gaariidha 2=gaariidha 3=quubsaadha 4=xiqqaadha

41. Lafa waliinii/sulula keessa marga funaantanii ni gurgurtuu? 0=lakkii 1=eeyyee
42. Hojiin misooma sululaa carraa hojii ni uumaa? 1=eeyyee 0=lakkii
43. G42^{ffaa} irratti yoo eeyyee jette, carraa hojii akkamiitu uumame?

lakk	Gosa carraa hojii	0=lakkii, 1=eeyyee	Hojiileen kun galii fi jiruu fi jireenya keessan irratti gahee qabaa? 0=lakkii, 1=eeyyee
43.1	Horii horsiisuu		
43.2	Gaagura fi kanniisa horsiisuu		
43.3	Jallisii hojjechuu		
43.4	Waldaa adda addaa hundeessuu fi hojiitti galchuu		
43.5	Hojiilee biqiltuu daffisuu fi dhaabuu		
43.6	Kan biraa		

44. Hojii misooma sululaa hojjechuun haala naannoo, hawaas-dinagdee fi hubannaa namaa irratti jijjiirrama ni fidaa? 1=eeyyee 0=lakkii
45. G44^{ffaa} irratti yoo eeyyee jette, erga hojiin misooma sululaa hojjetamee naannoo keessan keessti maaltu jijjiirrame?

lakk	Wantoota jijjiirrame	0) lakkii 1) eeyyee
45.1	uwwisni bosonaa ni dabale	
45.2	gabbinni biyyoo ni dabale	
45.3	qabeenyi bishaanii fi jiidhinsi biyyoo ni dabale	
45.4	baayoodaayivestiin dabaleera	
45.5	oomishni adda addaa ni dabale	
45.6	haalli jiruu fi jireenya(galiin) qonnaan bulaa dabaleera	
45.7	beekumsi/hubannaan namaa ni dabale	
45.8	Other	

46. Hojii misooma sululaatiif deeggarsi mootummaan/NGO godhe ni jiraa? 0) lakkii 1)eeyyee
47. G46^{ffaa} irratti eeyyee yoo, maal faadhaa?

lakk	Gosa meeshaa	0=lakkii, 1=eeyyee	Meehsaaleen kun sirriitti hojiirra ooleeraa? 0=lakkii, 1=eeyyee	Gahee meeshaaleen kun hojii misooma sululaatiif qabu sadarkeessi; 1=xiiqqaa, 2=g/galeessa, 3= olaanaa,
47.1	Filii/chigginyii biqiltuu fi margaa			
47.2	Meeshaalee akka			

	akaafaa, Gaabiyoonii/Gabion, burruusa, qoffortuu fi kkf			
47.3	Leenjii(motummaa fi NGO)			
47.4	Loojistikii keennuu(NGO)			
47.5	Deeggarsa bajataa(NGO) (lukkuu, hoolaa fi sanyii filatamaa ashaakiltii fi midhaanii)			
47.7	Kan biraa			

48. Sulula keessatti biqiltoota yeroo dheeraa (perennial crop) ni oomishtuu? 0) lakki, 1) eeyyee

49. G48 irratti yoo eeyyee jette, gosa kam oomishtuu?

	Gosa biqiloota yeroo dheeraa (perennial crops)	0) lakki, 1) eeyyee	Jiruuf jireenya keetiif si fayyadaa? 0) lakki, 1) eeyyee
49.1	maangoo		
49.2	Avocado		
49.3	muuzii		
49.4	burtukaana		
49.5	Appilii		
49.6	buna		
49.7	Habiibii (Currant)		
49.8	Qundoo barbaree/Fennel		
49.9	Wayinii/Grape		
49.10	Loomii/Lemon		
49.11	Anaanaasii/Pineapple		
49.12	Papaya		
49.13	Shankoora/Sugar		

50. Haala kamiin jiruu fi jireenya qonnaan bulaa irratti hojiin misooma sululaa gumaacha?

lakk	Jiruu fi jireenya/Livelihood components	0) laki 1) eyye
50.1	Qabeenya namaa/Human capital	Dandeettii/Skill/ability to labor
		Beekumsa/knowledge
		Tajaajila fayyaa/Health services
50.2	Qabeenya Uumamaa/Natural capital	lafa
		bishaan
		Qabeenya lubbu qabeeyyii/Biodiversity and wildlife
50.3	Qabeenya hawaasaa/Social capital	Wal'ta'nsa hawaasaa/Community network
		Miseensa garee/Membership of group
		Walitti dhufeenya hawaasaa/Relationship of trust
		Dhaabbileehaaasaa/Access to social institution
50.4	Qabeenya maallaqaa/Financial capital	Liqiifi qusannaa/Saving and credit
		Deeggarsa/Regular remittances
50.5	Qabeenya mul'ataa/Physical capital	Geejjiba/transport
		Mana/shelter
		Anniisaa/energy
		Qunnamtii/communication

Thank you for your advance cooperation!

Annex 5 : Conversion factors used to estimate Tropical Livestock Unit (TLU)

Livestock	Conversion Factors
Cow	1
Ox	1
Bull	0.6
Heifer	0.75
Calves	0.2
Donkey/Mule	0.7
Horses	1.1
Shoats	0.13
Poultry	0.013

Source: Stock, et al., 1991