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ASSESSMENT OF THE EFFECTIVENESS OF WATERSHED MANAGEMENT INTERVENTION IN CHENA WOREDA, KAFFA ZONE, SOUTHWESTERN ETHIOPIA

BY

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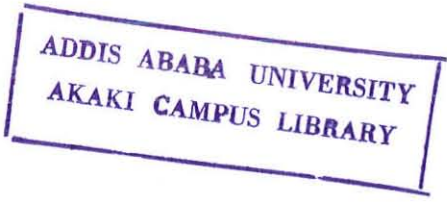
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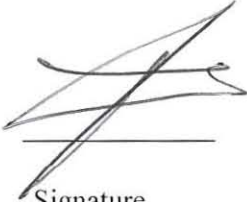



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This is to certify that the thesis prepared by Yericho Berhanu, entitled: *Assessment of the Effectiveness of Watershed Management Intervention in Chena Woreda, Kaffa Zone, Southwestern Ethiopia* and submitted in partial fulfillment of the requirements for Degree of Master of Arts (Water and Development) complies with the regulations of university and meets the accepted standards with respect to originality and quality.

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Abstract

Assessment of the Effectiveness of Watershed Management Intervention in Chena Woreda, Kaffa zone, Southwestern Ethiopia

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The main purpose of this study was to assess the effectiveness of watershed management intervention in Chena Woreda. The study used the quasi experimental design, and stratified sampling technique to select sample kebeles. In addition, random sampling method was used to select individual households from watershed management intervention and nonintervention areas. Both primary and secondary sources of data were used in the study. Primary data were collected through field observation, household questionnaire survey, focused group discussion, in-depth interview and key informant interview. Moreover, physical soil and water conservation structures layout measurement, laboratory measurement on soil fertility and water quality parameters were conducted. Descriptive statistics, t-test, chi-square test, participation index and binary logistic regression were used for data analyses. The study revealed that the intervention has good achievements in reducing soil erosion, improving water availability and quality, developing tree plantation, diversifying income sources, reducing of out-migration and increasing unity of the communities in the catchment. However, performing below the plan, poor community participation, lack of the structures design alignment with standards, inappropriate time of implementation, lack of diversified soil water conservation measures, absence of regular maintenance and management of the structures were some of the major limitation of the intervention. Therefore, this study recommends that the stakeholders should make appropriate correction measures for observed failures and further interdisciplinary study should be conducted to explore the problems.

Key words: Chena Woreda, Effectiveness, Intervention, Watershed

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Abbreviations

CSA-Central Statistics Agency

CWARD- Chena Woreda Agriculture and Rural Development Office

CWFEO- Chena Woreda Finance and Economy Office

CWHO- Chena Woreda Health Office

CWSLMP- Chena Woreda Sustainable Land Management Project

CWWD- Chena Woreda Water Desk

FAO- Food and Agricultural Organizations of United Nation

FDRF- Federal Democratic Republic Ethiopian

GTZ-Germen Technical Cooperation

MD-Mean Difference

Mg/l- Milligram per liter

MoA- Ministry of Agriculture

MoWR- Ministry of Water Resources

NGO- Non Governmental Organization

NTU- Nephelometric Turbidity Unit

PPM- Parts Per million

SLM- Sustainable Land Management

SLMP- Sustainable Land Management Project

SNNPR-Southern Nation Nationalities Peoples Region

SOS- Save the Children

SWC- Soil and Water Conservation

TLU- Total Livestock Unit

UNWWP- United Nations World Water Partinership

USDA- United States Department of Agriculture

WHO- World Health Organization

WSSD-World Water Summit on Sustainable Development

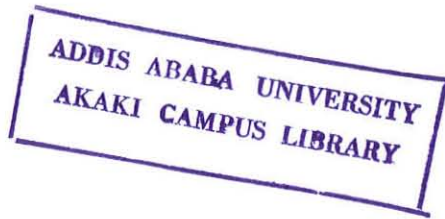


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CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Deforestation and accelerated soil erosion are the challenging issues in Ethiopia (Badege Bishaw, 2001). Converted forest lands are widely used for cultivation, fuel wood, grazing land, settlement and construction. Deforestation is going on at an alarming rate in Ethiopia in general and in south western parts of the country including Kaffa zone in particular. The high forest degradation rate, 22,500 ha per year of the Kaffa zone, is an indicator for fast rate of deforestation (Stellmacher, 2005). Deforestation increases runoff, reduces infiltration and water storage in the soil and results in loss of flora and fauna.

Accelerated soil erosion is the major threat to agricultural production in the country. It is estimated that about 1.5 billion tons of soil which has the monetary value of US\$1 to 2 billion per year is being eroded every year. The rate of erosion in highlands of the country is extreme and reaches up to 300 tons per hectare annually (FAO, 1984; Hurni, 1988; Tamirie Hawando, 1997). Out of 60 million hectares of estimated agriculturally productive land; 27 million hectares are significantly eroded, 14 million hectares are seriously eroded and 2 million hectares reached at the point which is irreversible (FAO, 1984). Deforestation and land degradation through accelerated soil erosion in turn results in low productivity and poverty in the country (Badege Bishaw, 2001).

Moreover, for the last several decades, different human activities such as developments in controlling and diverting surface waters, exploring ground water, overgrazing and over use of natural resources for a variety of purposes have been undertaken without care. Absence of conserving the natural resource, mismanagement of watershed and lack of preserving the quality of environment has greatly impaired the sustainable development of the country. The consequences include deforestation, land degradation, water shortage, pollution, flooding, impaired fisheries, and reduced recreational opportunities. The

findings of several studies in the country reveal that the uses of natural resource are exceeding the carrying capacity of the ecosystem. For instance, in Awash valley wetlands were dried up due to irrigation development projects, pastoral lands were transformed in to cotton production and extensive wetlands drainage resulted in drying up of 150 springs in Illubabor Metu Woreda (Abebe Yilma and Gehab(eds), 2003).

In order to alleviate the aforementioned problems, the role of watershed management is indispensable. Effective watershed management can prevent community water shortage, poor water quality, flooding and erosion. Consequently, the rivers, streams, wetlands and lakes of a given watershed area can provide ecological services that maintain the health, safety, economy and social welfare by storing and purifying drinking water, providing recreational opportunities that attract tourists, maintaining biological diversity, providing spawning opportunities for commercially valuable fish, raising property values, supporting agriculture, commencing and protecting people and property from flooding (Conservation Ontario, 2001).

Watershed development planning in Ethiopia with the aim of natural resource conservation and development programs was started in the 1980s (Hurni, 1986; Lakew Desta et al., 2005). The program focused merely on soil and water conservation for its first two decades of inception (Lakew Desta et al., 2005; Tesfaye Habtamu, 2011). However, now a day, it focuses on the wise use of natural resources such as land, water and vegetation in given watershed to obtain an optimum level of production with the minimum level of ecological degradation. The watershed development and management program of the country is adopting suitable soil and water conservation measures, providing adequate water for agriculture and domestic uses, and improving the livelihood of the community (Tefaye Habtamu, 2011).

Through support of Ministry of Agriculture and several NGOs, Kaffa zone has been implementing watershed management projects in different Woredas of the zone, of which the Sustainable Land Management Project (SLMP) implemented by FAO is one. The objective of the project is to support sustainable poverty reduction and the conservation of natural resources by developing and supporting approaches towards securing access to land (farm land and common lands) and improving the management of forests and

watersheds. The project also aims to monitor results and promote up scaling to areas with similar conditions in Ethiopia. As part of Kaffa Zone, Chena Woreda has started watershed management intervention in collaboration with FAO in 2008. The project is implemented in 13 kebeles of Chena Woreda (CWARD0, 2012).

The practice of soil and water conservation (SWC) through sustainable land management project (SLMP) has been developing in Chena Woreda. The commonly used SWC technologies (introduced by SLMP) in the Woreda include Physical structures and Biological measures. The Physical soil and water conservation structures such as Level fanny juu, Level soil bunds, Level stone fenced soil bunds and level stone bunds were constructed in the farmers' land. Biological SWC Measures such as distribution of coffee seedlings, tree seedlings and various grass species to farmers to plant on their own land were practiced through support provided by SLMP in the area.

1.2. Statement of the problem

In Chena Woreda many natural resources such as water, grazing land and natural forests is common sharing and always a source of conflict. The evidence in the area revealed that the people use these natural resources competitively for several decades (CWARD0, 2012). Moreover, Water with its distinctive physical features of mobility shared by the entire community and becomes root cause of conflict in the catchments of the Woreda. As water moves from upper catchment to downstream, the misuse of this resource in upper stream could adversely affects the downstream users. In addition, grazing land use competition among the community by maximizing the number of livestock is also the challenging issue for the Woreda. The area is also characterized by topography of mostly flat to undulating land with depressions and hills, and having the long rainy seasons. Hence, it is highly exposed to soil erosion and land degradation (CWFE0, 2012).

To overcome such problems, watershed management intervention has been introduced in the Woreda and further development programs are under planning stage (CWARD0, 2012). However, most of the communities in the Woreda in general and in watershed management implemented kebeles in particular are hesitating to accept the watershed management projects (personal observation, 2012).

The pre-assessment of the study conducted in the Woreda showed that the communities are divided in to two opposing groups and debating on the effectiveness of watershed management interventions. One group agreed that the watershed management intervention has brought adverse impacts such as decline in land productivity, pollution of water resources, deforestation and land degradation due its improper structures selection and implementation, improper timing of SWC structures development, ineffective community participation and limited sense of ownership created over assets, lack of integration among institutions and inefficient monitoring and evaluation techniques. On the other hand, other group agreed that the intervention has positive effects and brought sustainable watershed development in the catchment. Because of these diverging views among the community, they did not come into consensus about the effectiveness of watershed management intervention in the area and the Woreda Agriculture and Rural Development office is facing challenges for further implementation.

The experience in Ethiopia showed that the practice of evaluation of the effectiveness of the project is overlooked for three main reasons such as lack of political administrative commitment, insufficiency of budget allocated for monitoring and evaluation and inadequacy of the institutional arrangements that underlie monitoring and evaluation (Wassie Berhanu, 2000). Besides to the limited sense of evaluation of projects effectiveness, the studies conducted to evaluate watershed management were focused to evaluate the components of watershed separately (Mintesinot Azene, 2007; Azmeraw Ayehu, 2010; Tesfaye Habtamu, 2011). Due to this reason, it was difficult to know the overall effectiveness of watershed management of a given area.

Therefore, it is advisable to evaluate the overall effectiveness of watershed management intervention through scientific procedures. Hence, this study has incorporated several watershed management components such as environmental, economical, social, institutional and technical issues in an integrated manner.

1.3. Significance of the study

The study has provided important information about the effectiveness of watershed management. It is believed that the paper could contribute that the stakeholders to make

correction of failures in implementation of watershed management. It might provide important information for development actors, NGOs, the government and for all stakeholders. The lessons could be used not only for study area but also other similar areas. The paper could contribute to facilitate the exchange of ideas among local community, researchers and policy makers.

1.4. Objectives of the study

1.4.1. General Objective

The general aim of this study was to assess the effectiveness of watershed management interventions in Chena Woreda.

1.4.2. Specific Objectives

The specific objectives of the study were to:

- ❖ assess the effects of watershed management intervention on some biophysical components of the environment.
- ❖ assess the effects of watershed management intervention on household income sources in the area.
- ❖ assess the situations of social interaction in watershed management.
- ❖ assess the local institutional arrangement for watershed management.
- ❖ evaluate the technical viability of watershed management intervention.

1.5. Research Questions

In order to attain the aforementioned objectives, the following research questions were formulated.

- ❖ Do the land productivity, quality and quantity of water, and vegetation cover have been improving in the catchment?
- ❖ What impacts has come on the household income sources due to interventions?
- ❖ Did the stakeholders accept and participate in watershed management?
- ❖ How the watershed management institutions were arranged?
- ❖ Are the Watershed management intervention activities implemented properly?

1.6. Delimitation of the study

The study was confined by area. It was limited to Dega and Woina-Dega agro ecology of the rural kebeles' of the Woreda. Kola agro ecology a part of the area which accounts 2 % of the Woreda is not included in the study. Moreover, analysis of the appropriateness of SWC measures was limited to only cultivated lands.

1.7. Limitation of the study

This study has limitation. The effectiveness of the project was evaluated through comparing the mean outcomes of the variables in intervention and nonintervention areas. This approach has limitation since there might be systematic difference between the groups in addition to the watershed management intervention.

1.8. Organization of the Paper

This paper has five chapters. The first chapter deals with general background of the study, the statement of the problem, significance of the study, objectives of the study, research questions, delimitation and limitation of the study. The second chapter deals with literature review in which theoretical, methodological and empirical literatures were presented. The third chapter describes the materials and methods used in the study including the study area description, research design, types and sources of data, sampling technique, sample size determination, methods of data collection and data analysis techniques. The fourth chapter deals with results and discussion. In chapter five conclusion and recommendations were forwarded. Then at the end, references and appendices were presented.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Basic Definitions and Concepts

Watershed: *Watershed is a topographically delineated area that is drained by a stream system, i.e. the total land area that is drained to some point on a stream or river. A watershed is a hydrological unit that has been described and used as a physical-biological unit and also, on many occasions, as a socio-economic-political unit for planning and management of natural resources. Catchment is often used as a synonym for watershed (FAO, 1990). According to (Lakew Desta et al.,2005), Watershed is defined as any surface area from which runoff resulting from rainfall is collected and drained through a common confluence point.*

There is no definite size for a watershed. It may be as large as several thousand square kilometers for rivers or as small as only a few square kilometers of drainage area for filling of small ponds. However, for effective management the maximum size of watershed is suggested by ministry of Agriculture and Rural Development to range from 200 to 500 ha (Lakew Desta et al., 2005 ;Vishnudas, 2006).

The concept of watershed originates from surface hydrology where a river is assumed to be affected primarily by its surface drainage area. The main process in a watershed is the hydrologic cycle which summarizes the movement of water among surface water, air, land, and ground water. This process governs the physical, chemical, and biological characteristics of the ecosystems in a watershed. Watersheds are hydrological units that have been used as main spatial units for natural resources such as land, water and vegetation conservation and management (LaoMAF, 2006).

Watershed Management: *Watershed management is the process of formulating and carrying out a course of action involving the manipulation of resources in a watershed to provide goods and services without adversely affecting the soil and water base (FAO, 1990). Moreover, Taffa Tulu (2011) defined watershed management as a treatment of all*

natural resources of watershed to protect, maintain and improve water yield. Usually, watershed management must consider the social, economic and institutional factors operating within and outside the watershed area (FAO, 1990).

Watershed Management Projects/Interventions: These projects are abroad combinations of activities which includes tree planting, construction of soil and water conservation structures, road building, etc. in order to improve agricultural sustainability as well as to enhance the supplies of firewood, fodder, construction materials and drinking water (French, 1989). The term intervention in this paper refers to the broad combination of activities of SWC implemented in the Woreda through support of SLMP.

Effectiveness: Effectiveness is defined as the extent to which the objectives have been achieved (International Fund for Agriculture Development ,2003). Therefore, effective watershed management is the one that has achieved the planned objectives of the intervention. Therefore, this paper considered that Watershed management intervention that are designed and managed to maintain the function of environmentally friend, economically viable, socially acceptable, and institutionally and technically sound is effective.

2.2. Attributes of Watershed

Everyone is living in a watershed. People depend on watershed to get reliable water sources for drinking, bathing, cooking, recreation, agriculture and manufacturing. Yet different human activities like changing water flow for irrigation purpose can harm the watershed. Within a watershed activity on the land interact with the natural hydrological cycle. Nutrients and chemicals circulate in the watershed system and supply a basic nutritional source for aquatic and terrestrial species (<http://tycho.knowlton.ohio-state.edu/profile.html> accessed on August 09, 2012).

The biophysical components of a watershed are water, land and vegetation, and the socio economic elements and characteristics are population, farming systems, social setups, economic activities, vulnerability profile and gender. *Watershed planning is democratic.* It shows the views of various categories of people in watershed and all community are expected to benefit from watershed development. Moreover, the poor, vulnerable families

and women need special attention in watershed development planning (Lakew Desta et al., 2005).

2.3 Watershed Management in Ethiopia

In Ethiopia, there was no governmental policy on soil and water conservation and natural resource management prior to 1974. The 1974-1975 famine has made the turning point for the country to conserve her natural resources (Alemneh Dejene, 2003). The development of watershed management started 30 years ago with the general aim of natural resource conservation and development (Hurni, 1986; Lakew Desta et al., 2005). A large scale effort has made to implement the projects in the country. However, due its large scale planning units which range 30 to 40 thousands of hectares and absence of local community participation the projects were ended with unsatisfactory results. The failure of a large scale watershed management projects had opened an opportunity to the stakeholder's especially the researchers, governmental organizations and NGOs to find out solution for the problem. Hence, FAO in its pilot study from 1988 to 1991 found that watershed management approach which focus on a bottom-up basis and use smaller units is vital to attain the overall designed watershed management objective.

Accordingly, during the last two decades; MoA, GTZ and SOS Sahel have adopted participatory land use planning in different parts of the country. The interventions in South Gonder, North and West Shoa of Oromia, some parts of Tigray, North Wello and Wolaita were implemented by technical support of NGOs under ministry of Agriculture through participatory basis. Since 2005 the country has developed community based watershed development guideline. In which the participation of community gets due consideration for sustainable watershed development and management (Lakew Desta et al., 2005).

Currently, the movement on watershed management is going on almost throughout the country. Besides to the efforts made by several NGOs, the campaign on soil and water conservation program which was initiated by FDRE government for the last two years has offered a great renaissance in watershed development and management for the country.

2.4. Purpose of Watershed Management

The main purpose of watershed management is to improve soil and water conservation, irrigation facility, landuse pattern leading to increased agricultural productivity, poverty reduction, and better livelihoods and improved biophysical and socio-economy and would bring sustainable development (Singh et al., 2010). Hence, in Ethiopia, the main objective of watershed development through Soil and water conservation is to improve the livelihoods of community in rural areas and bring sustainable poverty reduction through productivity enhancement measures and optimum use of existing natural resources (Lakew Desta et al., 2005; Tesfaye Habtamu, 2011). Therefore, Soil and water conservation measures are applied to control runoff, improve soil fertility, conserve water, harvest excess water, improve food security and reduce poverty.

2.5. Types of Soil and Water Conservation Measures

A variety of soil and water conservation measures are well known. Different scholars classified the SWC type in different ways (Mitiku Haile et al., 2006). Kruger et al. (1997) classified SWC measures as Physical measures, biological measures and agronomical measures. Physical structures are also called mechanical or technical measures. The physical measures are structures built for soil and water conservation including bunds and terraces. Biological SWC measures are various types of vegetation including grasses planted for SWC purpose. Agronomic SWC measures include strip cropping mixed cropping, fallowing, crop rotation, intercropping, grazing management and agro-forestry (Ibid). Classification of SWC measures as modern and traditional is also commonly adopted. The World Overview of Conservation Approaches and Technologies (WOCAT) classified the SWC measures as Management measure (landuse change, area closure and rotational grazing etc.), Agronomic measure (mixed cropping, crop rotation, contour cultivation, mulching and etc.), Vegetative measure (grass strips, hedge barriers, windbreaks and etc.), Structural measure (terraces, bunds and etc.) and Combination of measures (WOCAT, 2003 cited in Mitiku Haile et al., 2006). Moreover, Mitiku Haile et al. (2006) have depicted both modern and indigenous SWC measures. Accordingly, modern SWC measures are newly introduced for the area and indigenous SWC measures are traditionally adopted by farmers. This paper has adopted Mitiku Haile et al. (2006)

classification systems/types since the local communities frequently used the terminologies in the study area. However, there might be occasions in which the other classification systems used for sake of simplicity.

2.6. Indicators of Effective Watershed Management

Indicators are measurable attributes of a system that can be used to determine condition of the system, usually relative to standards or references and to measure the ecosystem services being provided. Indicators can be defined in a number of ways and difficult to get single indicator for effectiveness of watershed management (Loucks, 2000). In some cases well defined standards can be used as best indicators while not in other cases. One of the criteria for effectiveness for a given watershed management may or may not be suitable for other in terms of temporal and spatial variation. Therefore, the combination of several indicators of effectiveness which integrate different issues is very important.

The overall effectiveness of watershed management is the function several factors including environmental, economical, social, institutional and technical aspects. Identification of indicators for each aspects and measurement on each attributes could provide information about the effectiveness of the project.

Environmental indicators provide information about the health of watershed. It provides the progress of changes in watershed. Improved soil fertility, water quality and quantity, flood protection, habitat restoration and increased vegetation cover in the area indicates the success of watershed management intervention (Ridolfi et al., 2010).

Debt reduction, diversified income sources and better employment opportunities created in the society would indicate economically variability of watershed management intervention (Singh et al, 2010).

Social indicators provide information about the social context, awareness, attitudes, capacities, constraints and behaviors in watershed management or project area. Increased awareness of watershed management activities, concerns, and increased knowledge of conservation practices and increased participation for watershed management could manifest the effectiveness of watershed management in terms of social context.

Therefore, Working with land owners to find out effective and practical solution to the problems is also crucial to achieve watershed management goals (Prokopy and Genskow, 2013).

Moreover, without effective and adaptive local institution the long term sustainability of watershed investment will remain questionable (Bekele Shiferaw et al., 2012). The same study has identified two main institutional components of effective watershed management intervention such as enabling institutions and organizational performance. Enabling institution focuses the rules for operation and management of various common assets and structures including mechanisms of conflict resolution, regulation behavior and agreed norms for sharing costs and benefits. Organizational performance focused on local mechanisms for coordination and implementation of watershed activities including user groups, committees and associations that determines the objectives and basic structures of authority and decision makings (Ibid).

The intervention should be technically sound. Appropriately designed and implemented physical structures could indicate technically viability of SWC structures. Proper selection of structure and timing of implementation are good quality of technically sound intervention (Hurni, 1986; Mitiku Haile et al., 2006).

The aforementioned lists of indicators are not exhaustive. To ensure the effectiveness of watershed management intervention, several key factors of each indicator should be identified and addressed with respect to the targets of the evaluation.

2.7. Soil fertility, Land Productivity and Watershed Management Nexus

Soil is the most fundamental and basic natural resource. Soil is used to produce food. However, it is prone to rapid degradation with land misuse. Productive lands are finite and that is less than 11 % of earths land area. Soil fertility is the quality or property that enables a soil to provide the proper compounds or mineral salts, in the proper amounts, and in the proper balance, for the growth of crops capability of a soil to produce a specified crop, or sequence of crop under a specified system of management (Akinrinde,2004). Fertile soil is reach in nutrients such as nitrogen, phosphorous and potassium that are necessary for basic plant nutrition. Fertile soil contains organic matter

which is responsible for the improvement of soil structure and soil moisture retention (Blanco and Lal, 2008). High yield of crop is a major determinant of successful farming and is dependent on optimum plant growth which in turn is controlled by soil fertility and productivity. *For a soil to be productive, it must of necessity be fertile. Yet, it does not follow that a fertile soil is productive* (Akinrinde, 2004; Brady and Weil, 2008). Therefore, proper land management is needed to reduce land degradation, improve soil fertility and increase the overall productivity of the land. The level (status) of fertility of the soil can be measured by measuring its nutrient content. The measurement of parameters like PH, Nitrogen, Phosphorous, and Potassium and Organic matter content of the soil could give information to determine the status of the fertility of a given soil.

Soil PH: Soil PH is a measure of the Acidity or Alkalinity in the soil. Soil PH affects the solubility of nutrients and activity of microorganisms responsible for breaking down of organic matter and most chemical transformation in the soil (USAD, 1998). Human activities can impact the level of soil acidity through Nitrogen amendments, acid precipitation and acid sulfate soils (Brady and Weil, 2008). During the last 100 years, the agricultural activities through large use of chemical fertilizers significantly accelerated the soil acidification in the world (Ibid). Widely used fertilizers such as ammonium sulfate[(NH₄)₂SO₄] and urea[CO(NH₂)₂] can oxidized in the soil by microbes to produce strong inorganic acid reaction and provide H⁺ ions that lower PH value in the soil (Ibid). The chemical reaction can take place in the soil as follows.



Sarkar and Haldar (2005) have classified the classes of soil PH in to nine classes. The classes and its value ranges were presented in Table 2.1 as follows.

Table 2. 1: Soil Acidity classes

Acidity/Alkalinity Class	PH value	Acidity/Alkalinity Class	PH value
Extremely acid	<4.5	Neutral	6.6-7.3
Very strongly acid	4.5-5.0	Mildly alkaline	7.0-8.0
Strongly acid	5.1-5.5	Strongly alkaline	8.1-9.0
Moderately acid	5.6-6.0	Very strongly alkaline	>9.0
Slightly acid	6.1-6.5		

Source: Sarkar and Haldar, 2005

Similar classification of the classes of soil acidity was also adopted by United States Department of Agriculture (USDA, 1998).

Nitrogen: Nitrogen is one of the most essential nutrients which limit the plant growth. Most soils contain large amount of nitrogen. However, most of nitrogen tied up in the organic fraction of soil and released slowly (Brady and Weil, 2008). Both deficiencies and excess of nitrogen have impact on ecosystem. Plants deficient in nitrogen has yellowish or pale green in leaf colors. The productivity of such plants is poor. Excess of nitrogen can adversely affect the ecosystem. The movements of soluble nitrogen compounds from soil to aquatic ecosystem by erosion can disrupt the balance of ecosystem. The large algae blooms and declining of the level of dissolved oxygen and death of fish and other aquatic species can happen (Akinrinde, 2004; Brady and Weil, 2008).

Phosphorus: Soil Phosphorous is an essential macro nutrient occurring in organic and inorganic forms in the soil. Usually phosphorous found in the soil in combination with other ions like Ca, Fe, Al and Fl. Naturally, the total quantity of phosphorus available in the soil is low and its range is between 0.02 to 0.15%. Phosphorous is not usually available very acidic soil (Akinrinde, 2004). Soils with low quantity of phosphorus has failed to produce crops and forced the poor people to clear forests to produce enough food to survive. This trend was widely experienced in sub Saharan Africa (Brady and Weil, 2008). Excess application of fertilizers which contains phosphorus can builds up its availability in the soil. Besides to application of fertilizers, the presence of livestock wastes can increase the availability of phosphorus in the soils of the watershed.

Table 2.2: Rating of soil fertility by available nutrients

Fertility	Organic Carbon (%)	Total Nitrogen (%)	Available P (ppm)
Excessive			>40
High	>0.75	>0.06	20-40
Medium	0.5-0.75	0.03-0.06	10-20
Low	<0.5	<0.03	<10

Source: Baruah and Barthakur, 1998; Marx et al. (1999); Sarkar and Haldar, 2005 for Total Nitrogen, Available P and Organic Carbon respectively.

2.8. Agriculture, Water Pollution and Watershed Management Nexus

Agriculture is responsible for surface water pollution. A significant eutrophication of surface water is arising from agriculture. Due to a high level usage of Nitrogen and Phosphorus, agriculture is responsible for proliferation of algae in the bodies of water (FAO, 1996). The ions which contain Nitrogen and Phosphorus from agricultural land moved with soil during soil erosion contaminate water quality. Nitrogen as Nitrate, Nitrite and Ammonia, and Phosphorus as Phosphate ions present in water bodies.

Nitrate is naturally found in the environment. Since it is an important nutrient for plants, humans are induced on agriculture land through fertilizer application. It can enter into water bodies through runoff. The amount of Nitrate should be less than 50mg/l as NO_3^- in drinking water (WHO, 2011). Similar to nitrate, humans can be induced to Nitrite in water bodies through fertilizer application. The amount of Nitrite as NO_2^- should be less than 3mg/l for drinking water (WHO, 2011). Ammonia (both non-ionized (NH_3) and ionized (NH_4^+) species) originates from metabolic, agricultural and industrial processes and from disinfection with chloramines. Natural levels of Ammonia in groundwater and surface water are usually below 0.2 mg/l (WHO, 2011). Animal farming can give rise to the level of ammonia in surface water. The presence of ammonia in water is an indicator for water pollution by bacteria, sewage and animal waste (Ibid).

Phosphorus is the eleventh most abundant element on the surface of the earth and is most commonly found as phosphate (Mahadevaiah et al., 2007). Phosphorus as Phosphate (PO_4) enters into water bodies from fertilizer applied on farm lands. The phosphorus enters

in the water through runoff can seriously pollute the water and jeopardize the drinking water supplies and the aquatic ecosystem (Brady and Weil, 2008). It could generate weeds and algae blooms in water bodies, change aquatic flora and fauna composition (McCaffrey, 2012).

Table 2.3: Rating of total PO₄ in water bodies

Category	Total PO ₄ (mg/L)	Category	Total PO ₄ (mg/L)
Low	0.06	High	0.15-0.45
Medium	0.06-0.15	Very High	>0.45

Source: McCaffrey, 2012

Manure produced by cattle, pig and poultry also constitutes serious problems for water quality in the world. Pesticides and insecticides are also responsible for water contamination (FAO, 1996). Therefore, Prediction of water quality impacts of fertilizer, insecticides, pesticides and related management practices is an essential element of effective watershed management.

2.9. Role of Local Institutions for Watershed Management

Most watershed management programmes launched were focused merely on development of soil conservation, improve land productivity and promote appropriate technologies for efficient and sustainable use of natural resources ,while less focus is given for institutional aspects (Dash et al., 2011). The recognition given for indigenous knowledge is less. However, the rural communities can manage natural resources through local management systems, and it is essential to address local specific complexes (Ibid). Therefore, the formation of local/ village institutions should be supported and implemented in a watershed management area, so that the effectiveness of activity taken up for watershed management is ensured.

Consequently, Participatory community-driven institutions of integrated watershed management are considered vital for the sustainability of natural resources.

2.10. Stakeholders' Involvement in Watershed Management

Stakeholders are organization group or individuals that is concerned with or has an interest in watershed and that would be affected by decisions about watershed management (MoWR, 1999).

Participatory watershed management which emphasis on people's indigenous knowledge in watershed management address the problems in watershed effectively, and offer economically viable, environmental sustainable, production oriented conservation alternatives (Dash et al., 2011). Empowering the stakeholders in decision making including watershed development, utilization, allocation, protection and control is essential. Decision making action taken through flexible and mutual coordination along with stakeholder participation is needed to bring sustainable watershed management (UNWWP, 2009). Cross-sectoral integration, cooperation and coordination are also important for better use of the scarce resources (Solanes and Gonzalenz-villarreo, 1999).

Therefore, local peoples must participate actively in every aspect from project design, implementation, maintenance, monitoring and evaluation of the project. Hence, the watershed management interventions should encourage the stakeholder participation especially women and poor, cross-sectoral integration, cooperation and information exchange. However, most the evidences in most literatures revealed that the community participation status in development projects were poor (Shah et al., 2004; Singh et al., 2010; Azmeraw Ayehu, 2010).The most determinant factors for poor community participation in most developing countries were difference in gender, age, educational level, family size, land size and the attitudes of the individuals (Azmeraw Ayehu, 2010).

2.11. Monitoring and Evaluation of Watershed Management Projects

Monitoring is the periodic review of the project inputs, activities, and outputs undertaken during implementation (Wassie Berhanu, 2000). Monitoring involves the process of collecting information about the actual performance of the project during implementation.

Evaluation is a process in which judgments on success and failures are made (Wassie Berhanu, 2000; Lakew Desta et al., 2005). It is also defined as systematic investigation of

the worth or significance of the project (Zarinpoush, 2006). A given Evaluation has its own purpose. The ultimate goal of evaluation is to determine the worth or merit of some procedure, project, process, or product. Project evaluation is an important tool to provide information for action such as decision makings, strategic planning and program modification. It also helps to understand the process, success and effectiveness of the project (Zarinpoush, 2006). It is done based on data either collected through regular monitoring or collected during evaluation process (Westat et al., 2002).

2.11.1. Types of Evaluation

Different scholars classify the types of evaluation in different ways. Westat et al. (2002) classified evaluation in to two such as formative evaluation (*assesses ongoing Project activities*) and summative evaluation (*assess a mature project's success in reaching its stated goals*) (Ibid). On the other hand, Wassie Berhanu (2000) identified three type of evaluation namely, ex-ante evaluation, ongoing evaluation and ex-post evaluation. Ex-ante evaluation is undertaken before the project starts. This evaluation examines the feasibility of the project. Ongoing evaluation also called concurrent evaluation. Concurrent evaluation is undertaken during project implementation to analyze the relationship between the project outputs and its effect in order to adopt the changes in the environment. Ex-post (impact) evaluation is done after the project has been implemented. It examines the effectiveness of the project in achieving its designed goal (Wassie Berhanu, 2000). Moreover, Lakew Desta et al. (2005) have classified evaluation as process evaluation, outcome evaluation and impact evaluation. Process evaluation is undertaken to measure the implementation of activities and how effectively this is done. Process evaluation helps the stakeholders to develop better understanding on the functioning of the program. Outcome evaluation is used to measure the effect of activities implemented. Impact assessment is used to measures the long term consequences of the project (Lakew et al., 2005). On the other hand, Zarinpoush (2006) has adopted four types of evaluations including formative evaluation, process evaluation, summative evaluation and outcome evaluation. Therefore, this paper mainly focused on outcome evaluation and tried to assess the extent to which the project has achieved its intended objectives.

2.11.2. Methods of Evaluation

Several methods of project evaluation were adopted at different time in different place. Some of the commonly used evaluation techniques are expert /peer review, data based evaluation, comparison of groups design and comparison of the before and after situation of project (Asian Development Bank, 1999; Bledsoe and Graham, 2005; Woolcock, 2009).

Expert/ Peer Review: it is associated with the judgement of based information. The peer might be an individual or committee. The review may include field visit, interview with stakeholders, review of document and a combination of methods. Expert/ peer review can be done quickly with low cost while it totally depends on the Knowledge, experience and viewpoints of the expert or peer.

Data Based Evaluation Method: This method uses descriptive analysis in which the descriptive statistics used to characterize a program, its participants and the attributes (relevant to social, political, economical and environmental) for the purpose of understanding who and why the program works.

A Comparison Groups Design (With and without): a group of people or institution who participated in the program is compared with a similar group who don't participate in the program. Difference in the pre- specified measures of impact or outcome between the two groups is attributes of the intervention.

Comparison of before and after intervention situation: A comparison is made on the situation of the area before and after the intervention implementation. Difference on the pre specified measures of impact between before and after is attributes of the intervention (Asian Development Bank, 1999).

Rigorous evaluation is the one that deploys the best available assessment tools and techniques at intervals that corresponds to the shape of project (Woolcock, 2009). Bledsoe and Graham (2005) have recommended that the evaluators to use a multiple evaluation approaches of project evaluation. By doing so, the viability and fidelity of the evaluation can be enhanced (Ibid).

2.11.3. Evaluation Tools

Evaluation tools help to gather information needed to answer the evaluation questions. The evaluation tools could be formal or informal. The formal evaluation tools include Focused group discussion, Interview and Survey questionnaire. On the other hand, informal tools are Observation, informal conversation and site visits (Zarinpoush, 2006). Besides the aforementioned tools, document review, and gathering information on stories, anecdotes, opinions could help to evaluate the project. Based on the evaluation purpose, the use of evaluation tools could vary (Ibid). The one viable for one specific objective could not be viable for the other. Moreover, the use of only single tools could not give sound information for evaluation. Therefore, it is advisable to use several tools of data collection for viable information and evaluation.

2.12. Review of Empirical Studies

A number of studies have been conducted in Ethiopia as well as abroad in relation to the watershed management. Some of them are: Singh et al., (2010), Tesfaye Habtamu (2011), Azmeraw Ayehu (2010), Gedeno Mollo (2009), Hailemariam Birke (2009), Birhan Sisay (2009) and Mintesinot Azene (2007).

Singh et al. (2004) has studied the impacts and effectiveness of Watershed development programmes in India. The evaluation was conducted by various agencies across different parts of the country. The study involved secondary data sources review and analysis of reports submitted by the agencies. They tried to systematically analyze through comparison of common indicators to provide a general overview of the impacts and effectiveness of watershed development. The finding indicated that the watershed development program has brought positive improvements in many parts of the country in which improvement in water quality, reduction in soil erosion, increment in surface and ground water, positive change in land use pattern, cropping intensification, reduction in work burden and debt position, involvement of community based organization, active community participation, reduction in migration, improvement in women employment were noticed in India

Tesfaye Habtamu (2011) studied the prospects, approaches and barriers of integrated and sustainable watershed management in Dijjil, Tsegur Eyesys and Lencha Dima watersheds in Amhara regional state. The study examined the existing complex set of biophysical and socio economic conditions, stakeholder's attitudes and perceptions, arrangement of participation of communities, available institution structures and recent policy of land certification in the area. Direct observation, semi structured interviews and reviews of official documents were used for gathering of information. Tesfaye found that effective and sustainable watershed management can take place through participation of watershed community from the beginning. The same study agreed that 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 has great role for effective and sustainable watershed management.

Birhan Sisay (2009) studied in identification of constraints in relation to adoption of soil and water conservation practices in Meket Woreda north eastern Ethiopia. Data were collected through sample household survey, focus group discussion and key informants interview by using structured questionnaires and semi structured checklists. Descriptive statistics and binary logistic regression model were employed in data analysis. The result depicted that demographic, socio economic and institutional factors influence the household's commitment to soil and water conservation measures adoption. The study also found that farmers' level of perception on soil erosion and farmers experience in farming and extension services increases the likelihood of adoption of soil and water conservation measures.

Hailemariam Birke (2009) studied the challenges of sustainable land management in foothills of Entoto Mountain. His study is mainly focused to investigate challenges in terms of farmer's perception on the problems and causes of soil erosion, constraints of existing sustainable land management practices, biophysical, socio economic and institutional challenges for promoting sustainable land management. Personal observation, interview with randomly selected households, focus group discussion and

key informant interview were conducted for data collection, and descriptive statistics were used for data analysis. Hailemariam found that most farmers have a good perception on controlling soil erosion. However, the same study revealed that the existing practices did not effectively implemented to control soil erosion due to land shortage, labor shortage, rodents, conflict, lack of knowledge and other related issues. Moreover, unregulated grazing, mono-cropping and engagement in non- sustainable off farm income diversification such as stone and fire wood sales constrained sustainable land management.

Gedeno Mollo (2009) conducted study on sustainability of SWC practices in Konso special Woreda, SNNPR with special focus on examining of the factors which undermine it. Household survey, focus group discussion, Key informants interview and direct observation were used as main tool for data collection. He had also used secondary data from books, reports and related studies. Gedeno used qualitatively description and quantitatively frequency, percentage and mean values for his analysis. He found that the overall trends of SWC practice has been deteriorating due to weakening of the role played by traditional institutions, decrease in the willingness of the households members to involve in the practices, decrease in assistance gained from outside, decrease in participation of youth in the practices, deterioration of social norms and decrease in farm productivity.

Mintesinot Azene (2007) has studied the effects and problems of managing environment resources to enable transition to more sustainable livelihoods watershed management projects in Kebelie-Chekorit sub catchment, Amhara regional state. The study used formal survey, focus group discussion, key informants interview, laboratory analysis and review of secondary documents as the main tools for data collection. Mintesinote found that the watershed management project has contributed its role by maximizing the amount of food crop production, creating employment opportunities and increasing awareness among the community in the area.

Most studies conducted in Ethiopia for the last two decades were mainly focused on examining the effects, problems and challenges of watershed management. Such studies were conducted mainly in northern and central parts of the country with exception of

Gedeno Mollo (2009) in South. Thus, the relevant data in relation to effectiveness of watershed management in SNNPR in general and Southwestern in particular is limited. Therefore, this study would contribute through filling the empirical evidence gaps in Southwestern parts of the country.

2.13. Conceptual Framework

As presented in Figure 2.1, effective watershed management is a function of environmental, economical, social, institutional and technical issues. The meaning of each pillar in this paper is based on the following explanation.

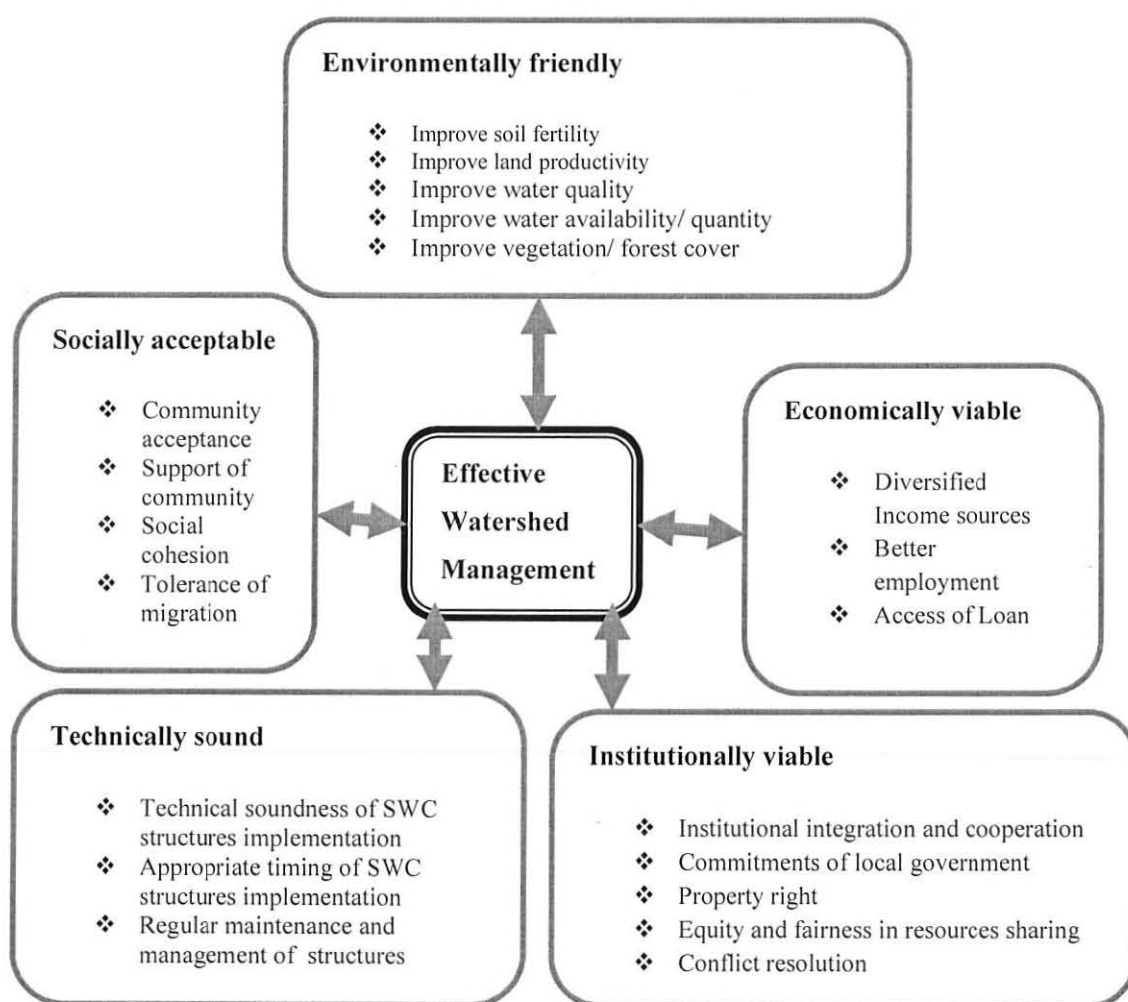


Figure 2.1: Conceptual Framework

Source: Developed by using different literatures

Environmentally effective watershed management should effectively conserve land, water and vegetation in the area. It should be designed to protect vegetation cover, reduce the rate of soil erosion and improve soil fertility, improve both quality and quantity of water resources through in-situ conservation of rain water and etc.

Economically effective watershed has also focus on improvements of household income and improvements of production and productivity in the catchment. Crop intensification through sequence cropping and maximizing farm income through agricultural related activities such as dairy, poultry, sheep and goat farming are essential to attain this objective.

Socially effective watershed management is a watershed management intervention which is accepted and supported by all stakeholders. Active community participation in the program including women's and minority groups and tolerance to migrants can be an indicator for socially effective watershed management.

Institutionally effective watershed should integrate and cooperate with others and actively solve conflicts. Strong institutional arrangement, through establishing watershed committee and effective community organization for conflict resolution and wise resource management, should be formulated for viable watershed management. The property right created over natural resources and fairness in resource allocation and utilization are an essential for over all viability of watershed management. The watershed management institutions which support and encourage the commitment of local government and the interest of stakeholders are also viable.

Technically viable: The SWC measures should be constructed in a proper way through standards and implemented in appropriate time to maintain the ecological balance of the area. The regular management and maintenance of the structure is an important for viable structure development.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Chena Woreda which is geographically located between 7° up to 7°45'N latitude and 35° 69' up to 36°06' E longitude. Chena Woreda is situated in Kaffa Zone of the Southern Nations, Nationalities and people's region (SNNPR). It is about 510 km away from Addis Ababa: the capital city of Ethiopia to Southwestern on the main road of Jimma to Mizan Teferi, and it is about 70 km from the zonal town of Bonga (CWFE0, 2012)

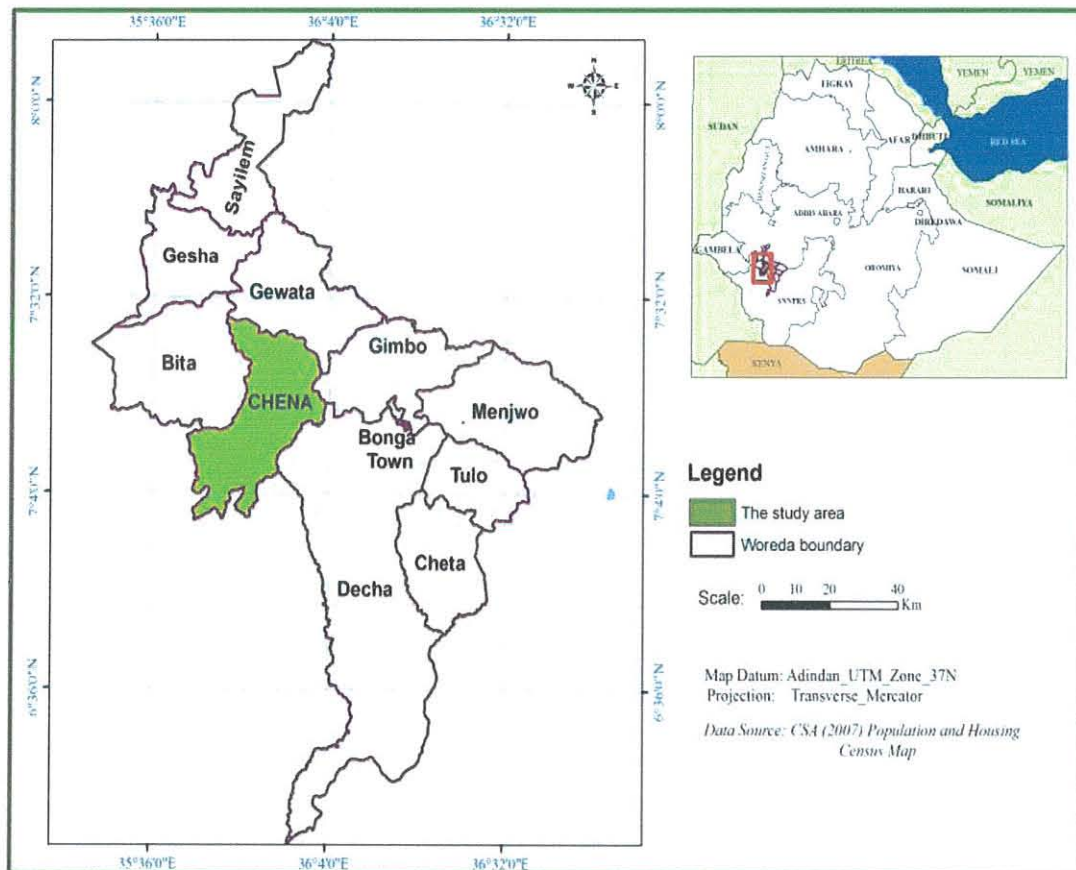


Figure 3. 1: Location of the study area

The total area of Chena Woreda is estimated to be 901.92 km² (Tezera, 2008; CWFEO, 2012). The Woreda has total of 44 kebeles, of which 42 are rural kebeles and 2 are developing towns. Based on the Central Statistics Agency of Ethiopia Statistical Abstract of 2011, the total population of Woreda was 183,335: consisting of 90,400 men and 92,935 women in (CSA, 2011). The rural kebeles has total of 24,144 households: of which 21,144 households are male headed and the remaining 3564 households are female headed (CWFEO, 2012).

The Woreda receives rainfall almost all the year round (Tezera Chernet, 2008). The average annual minimum and maximum rainfall is 1379 mm and 1889mm respectively (CWFEO, 2012). The mean monthly temperature ranges from 14 to 28^oc. The altitude of the Woreda ranges from 1000 to 3000 m.a.s.l. The agro-ecology of the Woreda is mainly moist woina dega (Ibid). According to the Woreda health office annual report of 2011/12, the agro-ecology of the area has 85 percent woina dega, 13 percent of dega and 2 percent of kola.

The soil of Woreda is not well studied. However, Soil map produced by (Woody Biomass Inventory and Strategic Planning Project, 2004) cited in (Tezera Chernet, 2008) shows that the study area has Dystric Nitosol.

Agriculture is the main source of household's economy in the area. The dominant crops grown in the area are Maize, Teff, Sorghum, Beans and Wheat. Besides, enset has a significant role for household's foods security for the Woreda. Livestock production is also the major source of the household's economy in the study area. Cash crops mainly *Coffee* and *chat* has also significant contributions in the area (CWARD0, 2012)

3.2. Research Design

The study used Quasi- experimental design, in which the matched area comparison approach was used. The comparison was conducted between watershed with management intervention and watershed without management intervention in the Woreda.

3.3. Types and Sources of Data

Both qualitative and quantitative data were used for the study. The data were collected from both primary and secondary sources.

3.4. Sampling Techniques and Sample Size Determination

Multi-Stage sampling technique was employed for selection of sample kebeles. The kebeles were grouped in to more homogeneous category through stratification. The main criteria for this stratification were the settlement type, agro ecology of the area and the presence or absence of watershed management intervention in the kebeles of the Woreda.

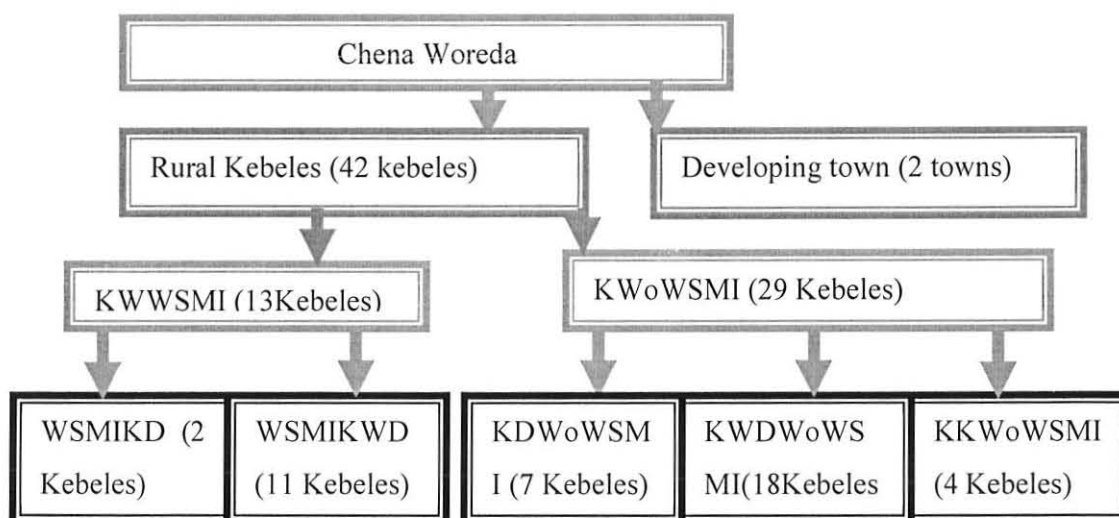


Figure 3.2: Diagrammatic representation of the stratification for sample kebeles selection

Where: KWWIMI is Kebeles with watershed management intervention, KWoWSMI is Kebeles without Watershed Management intervention, WSMIKD is watershed Management intervention kebeles in Dega, WSMIKWD is Watershed Management intervention Kebeles in Woina Dega, KDWoWSMI is kebeles in Dega without Watershed management intervention, KWDWoWSMI is Kebeles in Woina Dega Without watershed Management intervention and KKWoWSMI is Kebeles in Kolla Without Watershed management intervention.

After the stratification has done, total of four kebeles: one from each stratified group was selected through systematized selection method. Accordingly, Woda-Kulish from Dega watershed with management intervention, Wota-Wora from Woina Dega watershed with management intervention, Dosh-Kosa from Dega watershed without management intervention and Boba-Bela from Woina Dega watershed without management intervention were selected purposively from their respective group. The purposive selection was done in order to use best matched watersheds for comparison.

On average each kebele in the Woreda has 500 households (CWARD, 2012). Hence, the selected four sample kebeles have total of 2000 households. Taking sample size of 10% of population for the total population more than 1500 is sufficient (Gay et al., 2009). Therefore, 10% of households which was 200 households; proportionally 50 households from each sample kebele were used for the questionnaire survey.

Selection of individual household from all sample kebeles was done through systematic sampling technique. The selected household member either male or female who has age above 18 was used for household survey. Besides to household survey, 8 focus group discussion and 12 key informants interview was conducted. The discussion has incorporated six people in each group. Community elders, youth and females were included in the focused group discussion.

In order to collect soil sample, the sample households' land plot were used. The total number of sample household was 200 and therefore, it was expected that 200 sample plots of land to be used for soil sample collection. However, total of 108 land plots were used for soil samples collection, of which, 54 samples were from watershed management intervention and the remaining 54 from nonintervention area. The sample size is determined based on the budget availability, and it is advisable to have more sample size. However, with support of field observation and data from household's questionnaire survey, the samples represented the area.

To assess the quality, total 6 rivers were selected for sample water collection. Determination of the sample river was done based on the availability of water sources in the Woreda (4 main rivers of the Woreda and at least 6 small rivers on average in the

kebeles). Accordingly, 2 main rivers namely; Chuka and Meni were selected based on their nearness to sample kebeles and the flow directions of small rivers in the catchment. The remaining 4 small river samples were randomly selected from sample kebeles. From each river, three samples were measured at a time with three replications at 10th and 20th day of the first sample collection and measurement. Therefore, total 54 water sample was measured in laboratory including 27 from intervention area and the remaining 27 from nonintervention one. Similar to soil sample size determination, the water sample size is determined by budget and time shortage, and it is also advisable to collect more samples. However, with the support of data collected from field observation, focus group discussion, key informants interview and households questionnaire survey the sample would represent the total rivers.

3.5. Methods of Data Collection

Before beginning the actual work, permission was requested from the local administrations to carry out the research. Formal and informal discussions with leader of peasant association, district institutions, and villagers were conducted. Based on the information obtained from the discussions data collection process was employed through field observation, household questionnaire survey, focused group discussion, key informants interview, and laboratory measurements and review of documents.

Field Observation: Field observation was focused on observation of biophysical characteristics of Watershed like land degradation, crop patterns, distribution of settlements, individual activities in the farming plots, farmers' land management practices, water resources, bush and grazing lands, and other relevant aspects in the catchment. The observation was covered all sampled kebeles in the study area. During this field observation river course characteristics including water quality, availability, color and odor of water, water source protection systems or mechanisms and ecological conditions were observed.

Household Questionnaire Survey: It was used to collect the primary data from sample households. The survey was conducted by using both open and closed ended structured questions. It was focused on individual household's characteristics on both intervention

of watershed management and nonintervention. Also it was focused to get information on farmer's field practices of land resource management. The household survey was conducted based questionnaires prepared for this purpose.

Focused Group Discussion: Focused group discussion was conducted based on checklists and semi-structured questionnaires prepared for this purpose. At this session, the information on resource use interactions, resource allocation systems, female participation in resource management and related issues was raised and forwarded for analysis.

In-depth Interview: in-depth interview was used for collection of data. During this session, the people or respondents expressed their opinions, views, feelings and perspectives about the project process and outcomes.

Key Informant Interview: It was carried out with 4 elders, 4 local administrators and 4 experts. Identification of key informants who have deep knowledge about the area was essential task. They have deep-rooted experience and knowledge of their environment, which is vital to know the details of watershed management in the area. They can also play significant role in leading local institutions as they were highly respected in the community. Thus, gaining their consent was an important step. Contacts with development agents and agricultural experts were also of vital to assess the extent of watershed management interventions.

Soil and Water Conservation Structures Layout Measurement: This activity was conducted on sample households' field in the intervention area. It was done by using meter, clinometers, water level, ranging pole and other related materials. At least one SWC structure measurement was taken in their type on individual sample households' field.

A given physical structure may or may not be suitable for all areas. The structure suitable for Dega agro ecology may not be for Woina Dega. Similarly, the one suitable for cultivated land may not be for grazing land and vice versa. Moreover, the soil type (soil depth) also determines the suitability of a given physical SWC structures for specific area. Therefore, identification of an appropriate SWC structure for specific agro- ecology,

land use type (Cultivated land, Forest Land, Grazing land) and soil depth is crucial task for effective watershed management. Consequently, evaluation of the appropriateness of implemented Physical SWC structure based on local agro- ecology, land use type and soil depth were conducted.

Laboratory Measurement: Soil and water samples were measured in the laboratory.

Soil Sample Collection and Measurement: The soil sample was taken from the depth of 0 -20 cm since the intervention has immediate effects on top soil. The collected soil samples were air dried, mixed well and passed through 2mm sieve and the laboratory measurements was conducted by using the standard procedures. The measurement of soil parameters was mainly focused on Carbon, Nitrogen, Phosphorus and PH since they were good indicators of soil fertility.

Soil PH-H₂O was measured by using PH meter in a 1:2.5 soil: water ratio, Organic Carbon was measured by using Walkley-Black Method (Titrimetric determination), Nitrogen was measured through the use of Micro-Kjeldahl distillation and titration method and Phosphorus was measured by using Olsen method.

Water Sample Collection and Measurement: The water samples were collected from the main flow of the Sample Rivers. Water Quality parameters such as Temperature, PH, Conductivity, Turbidity, and Nitrogen as Nitrite, Nitrate and Ammonia and fecal coliforms were measured. Temperature was measured by using thermometer. The PH and conductivity of water was measured by using PH meter and conductivity meter respectively. Turbidity was measured by using turbidity tube. The measurement of Ammonia was conducted through the use of the Wagtech Water Technology Division ammonia test based on Indophenol method. Nitrate was determined through using the Wagtech Water Technology Division Nitrate test method. Nitrite was measured by using the Wagtech Water Technology Division Nitrate test method. Nitrate was also measured through the use of Nitrate Color Match Method. Phosphate was measured by Spectrophotometric method. The amount of fecal coliforms was also measured by Wagtech Water Technology Division method through the use of Potakit.

Secondary Sources: Both published and unpublished materials such as books, reports, and statistical abstracts, research journals, and policy and strategy documents were also consulted. The land use systems, land cover change and the total land area rehabilitated through intervention data was collected mainly from these sources.

3.6. Data Processing and Analysis

Editing and coding of collected data were made. The process of examining the raw data in order to detect errors and omissions and to make correction if possible was done. After completion of editing the process of assigning numerical symbols (coding) to answers were done and then the collected data were entered in to Statistical Package for Social Science. Then, descriptive statistics, t-test, chi-square test, participation index and logistic regression model were used for analysis.

Descriptive Statistics

Descriptive statistics such as frequency of information, percentage, mean and standard deviation was used. Descriptive statistics is used not only for quantitative data but also for qualitative data. Frequency of information was mainly used to analyze qualitative data. Furthermore, conversion of qualitative data (mainly for categorical data) in to numeric by using conversion factor was employed and descriptive statistic was used for the same.

T-test and chi-square test

The independent and one sample t-test was used. Independent t-test was used to compare the means of the parameters in intervention and nonintervention areas. One sample t-test was used to compare the observed means of SWC structures layout with the standards. Chi-square test was also used to compare significance the mean variation between the two groups of the categorical variables.

Participation Index

To assess the participation status of the respondents as well as the community in watershed management, the calculation of the index value were done. First, determination

of individual respondent's participation was done by using the following equation (equation 2).

$$PI_i = \frac{\sum_{j=1}^A Y_{ji}}{A} \quad (2)$$

Where PI_i = Participation index of the i^{th} respondent, $Y_j=1$, if the respondent has participated in the j^{th} activity, $Y_j=0$, if the respondent has not participated in the j^{th} activity and A = Total number of Activity

Then, determination of the participation status of the community in the catchment is employed through using the following equation (equation 3)

$$PI_c = \frac{\sum_{i=1}^N PI_i}{N} \quad (3)$$

Where, PI_c = participation index for the community, PI_i = Participation index of individual respondent and N = Total number of respondents

Binary logistic regression model

Binary regression models such as logit and probit are commonly used to identify the determinants of dependent variables (Gujarati, 2004). Both models provide the similar results (Ibid). Because of its simplicity in use and interpretation of the results, logit model was selected to identify the determinants of participation in watershed management. In estimating the logit model, the dependent variable is participation which takes a value of 1 if the household participated in watershed management and 0 otherwise (Gujarati, 2004). The specification of the logit model is presented as:

$$P_i = \frac{e^{Z_i}}{1 + e^{Z_i}} \quad (4)$$

Where, P_i is the probability of participation in the watershed management intervention and Z_i is the linear combination of independent variables written as

$$Z_i = \beta_0 + \sum \beta_i X_i + u_i \quad (5)$$

Where $i = 1, 2, 3 \dots n$, β_0 = intercept, β_i = regression coefficients to be estimated, U_i = a disturbance term, and X_i = pre-intervention characteristics.

The probability a household belongs to the not to participant in watershed management is:

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \quad (6)$$

Then the odds ratio can be written as:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} \quad (7)$$

$\frac{P_i}{1 - P_i}$, is the odds ratio in favor of participating in watershed management. It is the ratio of the probability that the household would participate in the watershed management to the probability that he/she would not participate in the watershed management. Finally, by taking the natural log of equation (7) the log of odds ratio can be written as:

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \ln\left(e^{\beta_0 + \sum_{j=1}^n \beta_j x_{ji}}\right) = Z_i \quad (8)$$

$$Z_i = \beta_0 + \sum_{j=1}^n \beta_j x_{ji} + \varepsilon_i \quad (9)$$

Where, L_i is log of the odds ratio in favor of participation in the watershed management, which is not only linear in X_{ji} but also linear in the parameters.

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

In this chapter, the data collected from several sources were presented and discussed in detail subsequently. First, the characteristics of the selected watersheds, and the general profile of the respondents and the characteristics of household have been discussed. Then, the results that deal to answer the fundamental research questions and their implications were presented and discussed as well.

4.1. Characteristics of the Selected Watersheds

The general characteristics of the selected watersheds were presented in Table 4.1.

Table 4.1. General Characteristics of Selected Watersheds

Characteristics	Intervention area	Nonintervention area
Total land area(ha)	3217	3389
Topography	Flat, steep and undulating	Flat, steep and undulating
Agro-ecology	Dega and Woina Dega	Dega and Woina Dega
Settlement type	Rural	Rural
Population	6180	6320
Ethnicity	Keficho	Keficho
Indigenous SWC measures	Yes	Yes
Modern SWC measures	Yes	No

Source: Own Survey, 2013

As presented in Table 4.1, the two watershed area such as watershed with management intervention and watershed without management intervention were similar in their general characteristics expect the watershed management intervention program. Therefore, these results suggest that the two watersheds were nearly identical and comparable.

4.2. General Profile of the Respondents

Based on the household survey of the study, the analysis was made on the respondents profile such as sex, marital status, educational level, age of the respondents, family size and mean land size of the family, and presented in the following Table 4.2.

Table 4.2: The respondents profile

Variables	Category	Intervention		Non intervention		MD	χ^2	t-value	p-value
		Mean	SD	Mean	SD				
Sex (%)	Male	64		64					
	Female	36		36					
Marital status (%)	Married	100		96			4.1**		0.043
	Divorced	0		4					
Education (%)	Illiterate	53		56			0.181		0.67
	Literate	47		44					
Age(Year)		44.09	11.78	43.98	12.3	0.11		-0.07	0.897
Family size(no.)		6.18	1.84	6.32	2.29	-0.14		-0.48	0.634
Land size (Ha.)		2.125	1.47	2.15	1.24	-0.025		-1.3	0.897
Valid n		100		100					

* and ** means significant at probability level 10% and 5% respectively.

Source: Household survey, 2013

From the total of 200 respondents of both intervention and nonintervention sample kebeles, 128 (64%) and 72(36 %) of the respondents were male and female respectively. All the sample population (100) in the intervention and 96 respondents (96 %) in nonintervention area were married. The chi-square test result presented in Table 4.2 ($\chi^2 = 4.1, P = 0.043$) indicated that there was statistically significant difference in marital status between the two groups, since the significance value (0.043) is less than the probability level (0.05).

Furthermore, as indicated in Table 4.2, 53% and 56% of respondents in intervention and nonintervention area were illiterate respectively. The difference in education level of the respondents in intervention area and the nonintervention one was not significant. The statistical test result showed that respondents in intervention and the nonintervention area have similar educational status.

The mean age of the sample population is 44.09 year for intervention and 43.98 year for nonintervention area. The frequency of age distribution of respondents has shown that 92% and 94 % of people in intervention and nonintervention area were in working age group respectively, while the remaining has an age of more than 65 years. The independent t- test result in Table 4.2 showed that there was no significant age difference between the respondents in intervention and nonintervention area.

Similarly, the survey result presented in Table 4.2 demonstrated that the mean family size of the households in intervention and nonintervention area were 6.18 and 6.32 respectively. These figures are almost the same with the average family size (6.2) of the household of the Woreda (CSA, 2011).

The mean land size of the households in intervention area is 2.125 hectare, which is less than the mean land size of the households in nonintervention area (2.15 hectare).The difference in land size holding in both groups was not significant statistically (Table 4.2). This means that the populations both in intervention and nonintervention have equal land in terms of the size.

4.2. Effects of Watershed Management Intervention on Biophysical Components of the Environment

The effects of watershed management intervention on the selected biophysical components of the environment such as soil, water and forest were presented as follows.

4.2.1. Evaluation of Soil Fertility through using Local Indicators

Through discussion with the local communities, several local indicators of soil fertility were identified. The presence of black colored soil, cracks in the soil, deep soil and high crop yield without using fertilizer were the commonly used indicators of the fertile soil. On the other hand, presence of red colored soil, sandy soil, shallow depth soil, presence of drought resistance trees and low crop yields are indicators of infertile soil. Similarly, Kajiru et al. (2005) has identified the same indicators of soil fertility used by the local communities in Ndala River Catchment in Tanzania. Based on a diversified criteria and knowledge, farmers evaluated the fertility of soil in their own land and in their catchment. Farmers' perception about soil fertility status is more holistic than the other evaluation

methods (Kajiru et al., 2005). Therefore, the local farmers' perceptions about the status of soil fertility were used in this analysis.

The farmers in the study area agreed that fertile soil has capacity to produce good productivity. Having several locally used soil fertility indicators, farmers mainly associate the status of soil fertility with the productivity of land. The farmers manifested that the fertile soil is more productive than infertile. Conventionally, farmers in the study area categorize their land in to three fertility status namely: good, medium and poor.

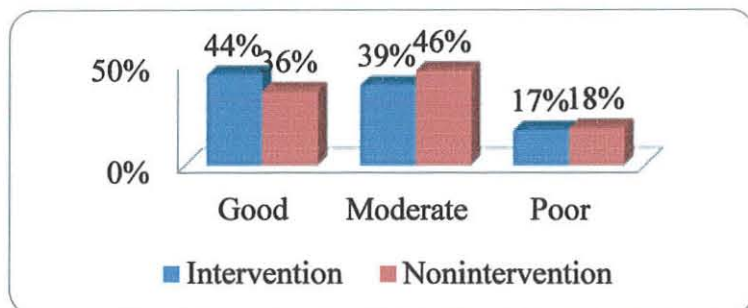


Figure 4.1: Percentage of respondents rating on soil fertility

Source: Household Survey, 2013

The household survey result depicted that majority of the respondents in intervention and nonintervention areas categorized their land in to moderate and good fertility classes (Figure 4.1). The survey result presented in Figure 4.1 also indicated that relatively high percentage of respondents (44%) in the intervention area responded that their soil fertility was good. As it is presented in Figure 4.1, relatively the soil fertility status in intervention area was better than the nonintervention one.

Table 4.3: Perceptions of farmers on soil fertility

Variables	Intervention		Non intervention		MD	t-value	p-value
	Mean	SD	Mean	SD			
Soil Fertility	2.27	0.74	2.18	0.72	0.09	0.876	0.192
Valid n	100		100				

N.B. 1 = poor, 2 = moderate, 3 = good, 4 = very good and 5 = excellent

Source: Household survey, 2013

However, the independent t-test result presented in Table 4.3 indicated that there was no significant variation of soil fertility between groups, since P-value (0.192) is greater than the probability levels (0.1, 0.05 and 0.01).

Table 4. 4: Perceptions of farmers on the rate of soil erosion

Variable	Response	Intervention	Nonintervention	χ^2	p-value
Rate of soil erosion	Increasing	3(3%)	100(100%)	188.35***	0.000
	Decreasing	58(58%)			
	No change	39(3%)			

***Significant at 1% probability level

Source: Household Survey, 2013

As shown in Table 4.4, 58 % respondents in intervention area responded that the rate of soil erosion which has great impact on soil fertility has been decreasing since 2008. However, 3% of the respondents complained that the watershed management intervention has posed the land to be eroded more and more. The remaining 39 % of the respondents of the intervention expressed that the watershed management intervention in the area had no change (remain constant) of soil erosion and soil fertility. On the other hand, all respondents in the nonintervention area inform that the trend of soil erosion is increasing from time to time in their respective kebele. The statistical test result presented in Table 4.4 depicted that there was significant variation in the responses of the respondents, and this showed that the intervention significantly reduced the soil erosion. Moreover, the information obtained from focused group discussion and key informants interview showed that the watershed management intervention reduced the rate of soil erosion. Therefore, it can be concluded that the watershed management intervention implemented in Chena Woreda has reduced the rate of soil erosion in the intervention area.

4.2.2. Soil Fertility Evaluation through using Chemical Parameter

The results of laboratory analysis of soil on selected chemical parameters are presented in Table 4.5.

Table 4.5: Laboratory results of soil fertility parameters

Parameters	Intervention		Non intervention		MD	t-value	p-value
	Mean	SD	Mean	SD			
PH H ₂ O	5.27	0.59	5.13	0.32	0.144	1.568*	0.06
OC (%)	3.15	0.37	2.99	0.8	0.153	1.271	0.104
TN (%)	0.32	0.05	0.29	0.09	0.028	2.1**	0.0195
Av.P (ppm)	19.22	10.82	19.02	5.42	0.2	0.121	0.452
Valid n	54		54				

Where OC is organic carbon, TN is total nitrogen and Av.P is available Phosphorus

** and ** means significant at 10% and 5% probability levels respectively.*

Source: Laboratory Result, 2013

Soil PH

The laboratory result of the soil PH in nonintervention area ranges between 4.73 and 5.7 with mean value of 5.13 ,while in intervention area it ranges from 4.49 to 6.63 with mean value of 5.27(Table 4.5; Appendix 1). The observed mean difference of soil PH between the two sites was 0.144. The independent t-test result showed that there was significant difference between the two means of the soil PH (Table 4.5). This indicated that the intervention has brought an improvement in soil acidity (increase the PH value). However, the mean values of the two sites (5.13 for nonintervention and 5.27 for intervention one) indicated that the soils are strongly acidic. This is because of that the PH value which ranges from 5.1 to 5.5 is strongly acidic (Sarkar and Haldar, 2005). This finding is consistent with the findings of Mintesinot Azene (2007). He found that the conservation activities in the intervention area contributed to the betterment of soil acidity.

Soil Organic Carbon (%)

The laboratory result presented in Table 4.5 showed that the organic carbon content in the intervention area (3.15%) is greater than the nonintervention one (2.99%). The mean difference of organic carbon between the two sites is 0.153. This mean difference is insignificant since the P-value (0.104) is greater than probability levels (0.1, 0.05 and 0.01). This means that there was no significant effect observed on soil carbon content due to intervention. This result is argued with the findings of Girma Deressa (2006). He found out that the soil and water conservation measures contributed for the improvements of organic carbon content in Tach-Gayint Woreda, Amhara regional state. The soil with the organic carbon content more than 0.75% has high soil fertility (Sarkar and Haldar, 2005). Therefore, the observed laboratory result depicts that both areas have high organic carbon content and fertility class.

Total Nitrogen of Soil (%)

As indicated in Table 4.5, the mean value of total nitrogen in nonintervention area is 0.29% with the value ranges from 0.18 to 0.39%. Similarly, in the intervention area, the mean value of total nitrogen is 0.32% with the values ranges from 0.27 to 0.39 % (Table 4.5; Appendix 1). The mean value of total nitrogen in the intervention area is greater than that of the nonintervention one (Table 4.5). The mean difference is 0.028%. The independent t-test result in Table 4.5 depicted that the mean difference was statistically significant. This significant variation of the results reveals that the SLMP has brought an improvement in total nitrogen content of the soil in the intervention area. This result is consistent with Girma Deressa (2006) and Mintesinot Azene (2007) in which they found out that the biophysical measures contributed to replenishing of soil nutrients.

According to Baruah and Barthakur (1998), both areas (intervention and nonintervention) have high total nitrogen content and can be classified as highly fertile soil class.

Available Phosphorus in the soil (ppm)

The observed mean value of soil phosphorus is 19.02 and 19.22 ppm for nonintervention and intervention area respectively (Table 4.5). The mean value of phosphorus in the

intervention area is greater than the nonintervention one with the mean difference of 0.2 ppm. However, the independent t-test result presented in Table 4.5 shows that the mean difference was not significant. This indicates that the watershed management was not contributed for the improvements of available phosphorous in the study area. This result is opposing with findings of Mintesinot Azene (2007). He found out that the rehabilitation project contributed to the improvements of phosphorous content in the soil. The mean value of Phosphorus presented in Table 4.5 showed that the available soil phosphorus in both site were medium since they are (19.02 and 19.22 ppm) with range of 10 to 20ppm (Marx et al., 1999).

The laboratory result presented in Table 4.5 depicted that there was significant change observed in soil PH and total nitrogen due to watershed management intervention. On the other hand, there was no significant change in organic carbon and available phosphors contents of the soil. The content of essential element in both sites indicated that the soil of the area is classified as fertile. However, the PH of soil in both areas is strongly acidic. Due to this reason, the productivity of the soil in both sites may not be as productive as expected.

4.2.3. Water Availability

According to CWWD (2012), the total water availability in the Woreda is characterized as good condition. The Woreda has four main rivers namely Chuka, Meni, Yegeni and Woshi which have continuous flow throughout the year. Besides, at least, six small rivers were available in each kebeles of the Woreda. According to the irrigation expert of the Woreda, the total amount of available water in the Woreda has the capacity to irrigate the entire cultivated lands of the Woreda. However, it was used below the capacity it had to be offered.

The local communities categorized the availability of water into three classes: namely, good, moderate and poor. The presence of water sources, the volume of water sources, its nearness to the settlement and constant flow rate of the water sources were the main criteria locally used to categorize the availability of water resources in the area. According to respondents, the area which has several water sources with continuous flow rate and nearest to the settlement is characterized as good. On the other hand, if the area

has no several water sources, fluctuated flow rate and far away from the settlement, the water availability is considered as poor. Moreover, if the case is in between the above two category (good and poor), the water availability is termed as moderate.

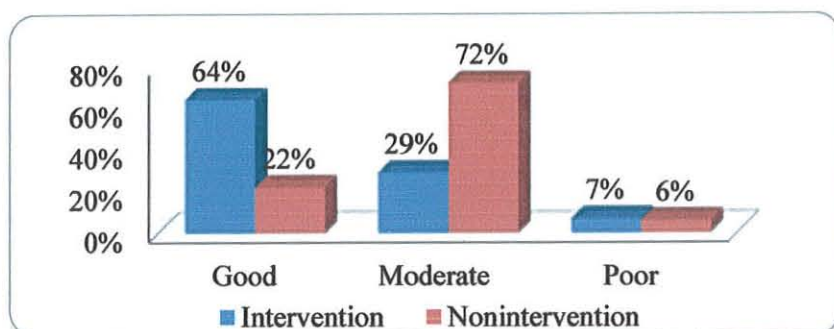


Figure 4.2: Percentage of respondents rating on water availability

Source: Household Survey, 2013

As presented in Figure 4.2, 64% of respondents in watershed management intervention area rated the water availability as good, 29% as moderate and 7% as poor in their catchment. On the other hand, 72 % of respondents in nonintervention area rated as moderate, 22% as good and 6% as poor (Figure 4.2).

Table 4.6: Respondents rating of the water availability

Variable	Intervention		Non intervention		MD	t-value	p-value
	Mean	SD	Mean	SD			
Water availability	2.57	0.62	2.16	0.51	0.41	5.1***	0.000
Valid n	100		100				

***means significant at 1% probability level

N.B. 1 =poor, 2= moderate, 3= good, 4= very good and 5= excellent

Source: Household survey, 2013

The independent t-test result presented in Table 4.6 indicated that there was significant variation in water availability in both areas. The figures in Table 4.6 manifested that the availability of water in the intervention area is better than the nonintervention one. In line with this, nearly half of respondents (48%) in the intervention area stated that the watershed management has contributed a positive (good) role to the improvement of

water sources in the area. All key informants also expressed that the SWC structures constructed on farm land have contributed to the water from rainfall to be retained in the soil and it enhanced the soil moisture content. This result is similar with findings of Singh et al. (2010) in India. Moreover, this result is consistent with findings of Tesfaye Habtamu (2011), in which he found out that the support of watershed management project has contributed for potential water sources availability in the catchment.

However, the trends of drying up of water sources, especially, springs and small rivers were noticed during field observation. Due to this reason, the color of water is changed from colorless in to yellow (Plate 4.1). As observed during field visit, the extents of drying up of water sources were relatively higher in nonintervention area than the intervention.



Plate 4.1: Drying up river at the source in the study area

Source: Field survey, January 2013

The household survey result depicted that the major sources of water for family consumption is obtained from rivers and springs. According to the majority of total respondents (175 out of 200 which is 87.5%) assured that their family member uses these water sources for drinking, washing, bathing and etc. Hence, the long distance family traveled to fetch water is the determinant factor for communities to use sufficient water.

Table 4.7: Distance traveled (km) to fetch water

Variable	Intervention		Non intervention		MD	t-value	p-value
	Mean	SD	Mean	SD			
Distance	1.97	0.577	2.06	0.499	-0.09	-1.18	0.119
Valid n	100		100				

Source: Household survey, 2013

The household survey result showed that the mean distance traveled to fetch water in intervention area was 1.97 km, while 2.06 km in nonintervention area. The mean difference result (-0.09) in Table 4.7 indicated that the distance traveled to fetch water in intervention area was shorter than the nonintervention one. However, the independent t-test result depicted that there was no significant distance difference between the two groups. The round trip to fetch water within 1km has basic access (WHO, 2011). Accordingly, the communities both in intervention and nonintervention area have no basic access. As it was mentioned in focused group discussion, the duty of fetching water is either women's or children's responsibility in the entire communities of the area. Therefore, women and children had to travel a long distance (1.97 km and 2.06 km) to fetch water in the study area.

4.2.4. Water Quality

The quality of water affects its use for particular purpose. Testing of the quality of water can tell us about its goodness. The evaluation of water quality for this study was conducted for the purpose of drinking water since rivers and spring were the source of drinking water in the area. Therefore, the observed result was compared with WHO standards of drinking water quality. The parameters used were Temperature, PH, Conductivity, Turbidity, Phosphorous, Nitrogen and Fecal coliforms. The observed results of the parameters were presented in Table 4.8.

Table 4.8: Laboratory results of the water quality parameters

Parameters	Intervention		Non intervention		MD	t- value	p- value
	Mean	SD	Mean	SD			
Temperature(o ^c)	19.92	1.34	21.56	2.07	-1.656	-3.484***	0.000
PH	7.66	0.303	7.99	0.269	-0.331	-4.242***	0.000
Conductivity(μs/cm)	30.29	2.612	52.24	9.85	-21.94	-11.19***	0.000
Turbidity(NTU)	20.87	4.747	22.89	4.886	-2.019	-1.54*	0.065
Nitrite(mg/l)	0.567	0.366	0.7	0.308	-0.133	-1.45*	0.077
Nitrate(mg/l)	10.79	6.291	11.78	4.551	-0.989	-0.662	0.255
Ammonia(mg/l)	0.744	0.199	0.778	0.172	-0.033	-0.660	0.256
Phosphate(mg/l)	0.685	0.166	0.696	0.174	-0.0104	-0.224	0.412
<i>Fecal coliforms</i> (no.)	26.19	25.03	75.37	50.18	-49.19	-4.558***	0.000
<i>Valid n</i>	27		27				

*and *** means significant at 10% and 1% probability levels respectively.

Source: Laboratory Measurement, 2013

Physical parameters

The PH value of both experimental groups was nearly neutral and at optimum range. The PH value which ranges from 6.5 to 8 is optimum for fresh water (WHO, 2011; McCaffrey, 2012). The mean difference of the PH of the water was -0.331 and variation is significant (Table 4.8). The conductivity of both groups is between 0 and 800 μs/cm (See Appendix 2), which is within the range of pure river water conductivity (McCaffrey, 2012). However, the two groups have significant variation of conductivity, in which the conductivity in the intervention area was lower than that of nonintervention one.

The mean turbidity of nonintervention and intervention sites is 22.89 NTU and 20.87 NTU respectively (Table 4.8). The mean difference of Turbidity between the two groups was -2.019, which is significant. Moreover, the observed mean of turbidity of both areas were beyond the drinking water quality standards in which the level of turbidity should be less than 5NTU (WHO, 2011).

Nutrients Content of Water Sources

The main plant nutrients are Nitrogen, Phosphorous and Potassium. Among these Nitrogen as Nitrite, Nitrate and Ammonia, and Phosphorus as phosphate was used for this study.

Nitrite (NO_2^-)

The laboratory result revealed that the amount of nitrite in intervention and nonintervention area was 0.57 mg/l and 0.7mg/l respectively (Table 4.8). As it is presented in Table 4.8, there was significant variation between the two means of nitrite. The independent t-test result presented in Table 4.8 shows that the amount of nitrite in the water bodies of the intervention area was significantly lower than in the water bodies of nonintervention area. However, the amount of nitrite presented in water bodies of both areas was less than the amount expected to be in drinking water (3mg/l) (WHO, 2011).

Nitrate (NO_3^-)

The amount of nitrate is 11.78mg/l for nonintervention area and 10.79 for the intervention area. The observed mean value showed that the amount of nitrate in the water bodies of nonintervention area was greater than the water bodies of intervention one. However, the mean difference was not significant (Table 4.8). Moreover, the observed results of both areas were within the limit of the nitrate amount that should be in drinking water which is 50mg/l (WHO, 2011).

Ammonia

As it was indicated in Table 4.8, the mean value of ammonia was 0.78mg/l for nonintervention and 0.74 mg/l for intervention area. There was no significant variation between the two means. The level of ammonia in both sites was beyond the limit of natural occurring of ammonia in the water bodies which is 0.2mg/l (WHO, 2011). Therefore, it clearly showed that there is human induced factor which raised the level of ammonia in water bodies in the area. Since agriculture is experienced in the area, the trends of fertilizer use and animal wastes were responsible for water pollution of the area.

Phosphate

As presented in Table 4.8, the mean value of phosphate was 0.685ppm for intervention site and 0.696ppm for nonintervention one. McCaffery (2012) rated the phosphate content in the water body which is greater than 0.45ppm as very high. Therefore, both areas phosphate content of water bodies is very high. The mean difference of Phosphate was -0.0104 which is insignificant.

Bacteriological Parameter

The Laboratory result showed that the mean amount of fecal coliforms counted in intervention area was 27 with the minimum counted 2 and maximum 100. On the other hand, the amount of mean fecal coliforms counted in nonintervention area is 75.37 with the minimum value of 0 and maximum of 205 (Table 4.8; Appendix 2). The mean amount of fecal coliforms counted in nonintervention area is nearly three times greater than the intervention one. Moreover, the mean variation of fecal coliforms between the two groups was significant. The results of both areas indicated that the pollution of water by faces and animal wastes.

The laboratory result presented in Table 4.8 and discussion with its implication revealed that all selected physical parameters, the nutrients and bacteriological content of water bodies in nonintervention area was higher than that of intervention one. The mean variation of Temperature, PH, Conductivity, Turbidity, Nitrite and fecal coliforms was significant. However, there was no significant mean variation in Nitrate, Ammonia and Phosphate content of water bodies of the two sites. In spite of having this controversy, the lower mean values of selected water quality parameters of the intervention area signify that the watershed management intervention has resulted in prevention of the soil erosion rate. Therefore, the entrance of nutrients in to water bodies from agricultural fertilizer use and animal wastes has been reducing. Besides to water quality parameters, all key informants and 47% of the respondents in intervention area agreed that the watershed management has brought an improvement in water quality in the catchment. Accordingly, it can be concluded that the watershed management intervention has contributed to the improvement of water quality. This finding has similar implication with the findings of

Shah et al. (2004) and Singh et al. (2010). They found out that the improvement in quality of ground and surface water were observed in Indian watersheds within short period of time due to watershed development program.

However, the overall qualities of water sources such as rivers and springs in the study area were poor in quality for drinking purpose when compared with WHO drinking water quality standards. Due to this reason, out of the total populations of rural kebeles of the Woreda, only 14.74 % used the quality water for their daily consumption such as drinking, washing, cooking and etc. The majority of the rural communities (85.26%) are using poor quality water for their daily consumption, even for drinking purpose (CWHO, 2012).

The major sources of water for daily use in the area (river and springs) are highly exposed to pollution due to its nature of openness for everything. In addition to human basic needs, rivers and springs are commonly used for drinking of cattle and wildlife in the area (Plate 4.2).



Plate 4.2: Multiple uses of the same river in the study area

Source: Field survey, January 2013

4.2.5 Forest Resource Management

Besides to the natural forest of the Woreda, the individual farmers have their own tree plants on their land. Trees on the farmers land are either planted by farmers themselves or grown naturally. For instance, plantation of eucalyptus is one of the trees widely planted by the farmers.

Table 4.9: Respondents regular planting of tree and tree stocks on farmers land

Variable	Response	Intervention Amount of respondent	Non intervention Amount of respondent	χ^2	p-value	
Regularly planting tree?	Yes	60	46	3.934**	0.047	
	No	40	54			
Variable	Mean	SD	Mean	SD	t-value	p-value
Tree stock(no.)	574.5	1380.77	351	1051.02	1.288*	0.099

* and ** means significant at 10% and 5% probability level respectively

Source: Household survey, 2013

The household survey result showed that the practice of regularly planting of trees (annually) was adopted by 60% and 46 % of respondents in intervention and nonintervention area respectively. The statistical test result presented in Table 4.9 shows that there was significant difference in tree planting practices between the communities of both intervention area and nonintervention area. The same results revealed that there was higher proportion of community members in the intervention area who were regularly planting trees than the nonintervention one. This result is in line with the findings of Tesfaye Habtamu (2011) in Tsegur and Tsegur Eyesus watershed. In which higher proportion of households were engaged in tree planting activities. Moreover, this finding is consistent with the findings of Mintesinot Azene (2007) in Kalu Woreda.

The main source of tree seedlings was individual and public nursery sites. However, the support of public nursery was restricted to only in intervention area. As it was observed during field visit, there was at least one public nursery site in intervention kebeles whereas there was no such in nonintervention kebeles.

As 83% of the intervention area respondents in the household survey said, the watershed management program has initiated the farmers to plant tree on their land through creating

awareness on the importance of trees and providing tree seedlings. The progressive reports of CWSLMP (2012) revealed that more than 100,000 tree seedlings were distributed for each intervention kebeles for the last five years. This means that the SLMP has provided more than 40 seedlings per household yearly in its intervention area.

The household survey result showed that on average individual farmers have 574 tree stocks in intervention and 351 in nonintervention area respectively. This shows that the proportion of tree stock in intervention area is higher than in nonintervention one. The independent t- test result presented in Table 4.9 depicted that there was significantly higher trees stocks in intervention than the nonintervention area. The standard deviation is higher for both areas (1380.77 for intervention and 1051.02 for nonintervention). This in turn, indicated that there was higher variation of trees distribution among farmers' land within the same catchments of both areas.

The farmers planted trees on their own land for the purpose of fuel wood consumption and house construction. All respondents confirmed that they do have full right to cut and use the trees planted on their own land when they need it to do so.

The role of SLMP in developing forest resources by creating awareness and providing tree seedlings in the intervention area is significant.

4.3. Effects of Watershed Management Intervention on Households Income Sources

The main income source of the community in Chena Woreda is agriculture. The annual reports of the Woreda Finance and Economy office (2012) indicated that more than 90 % of the Woreda population depends on agriculture for their livelihoods. The remaining (10 % of total Woreda population) depends either on government employment or commercial activity. Mixed farming which involves crop production and animal husbandry is adopted by all farmers in the Woreda.

4.3.1. Crop production

Crop production in the area includes the production of staple food crops, cash crops and cereal crops.

Enset is used as main source for food in the Woreda. However, the production of this staple food crop is limited to homestead and household consumption. Coffee production is also one of cash crops practiced on some framers' land. Coffee was used both for household consumption as well as for sell as income source. Coffee production activity by individual farmers is also limited to homestead area. Besides, the production of coffee by investors has been expanding in the Woreda.

Cereal crops such as Maize, Teff, Faba bean, Sorghum and Wheat were produced by all farmers in the area. The farmers used these crops mainly either for food or for sell. The focused group discussion participants proposed that the proportion of land used for maize production covers three fourth (75%) of the households total land size. Therefore, maize is the most widely produced of all cereal crops.

Table 4.10: Cereal Crop Production (Kg/ha/year)

Crops	Intervention		Non intervention		MD	t- value	p-value
	Mean	SD	Mean	SD			
Maize	835	614.2	797	357.8	37.6	0.529	0.264
Teff	315.5	237.3	282	141.3	33.5	1.213	0.114
Sorghum	937	798	677	429.9	139	1.732**	0.043
Faba Bean	677.6	560	557.5	259.8	117.6	1.912**	0.029
Wheat	634.5	464	666.6	219.4	170.5	2.429***	0.008
Valid n	100		100				

*** and *** means significant at 5 and 1% probability levels respectively*

Source: Household Survey, 2013

The calculated mean production difference presented in Table 4.10 showed that higher amount of all cereal crop production is observed in intervention area than the nonintervention one. The independent t-test result in Table 4.10 depicted that the production of Sorghum, Faba bean and Wheat in intervention area was significantly higher than in nonintervention area. On the other hand, there was no significant production difference of Maize and Teff in both areas.

The household survey result shows that the annual production of cereal crops has been decreasing in the Woreda. Similarly, the annual reports of Chena Woreda revealed that the production of the cereal crops in the Woreda has been declining (CWARD, 2012). Moreover, the focused group discussion, in-depth interview and key informants' information noticed the tendency of decline in production of all cereal crops the area. This finding is argued with the findings of Mintesinot Azene (2007). His study has found out that the watershed management project has contributed through maximizing the amount of food production.

The majority of key informants stated the reason of production decline in the Woreda as follows:

The main reason for decline of production and productivity of land in the area is not only because of land degradation but also improper extension program and climate change.

Land degradation: degradation of soil fertility due to overgrazing, deforestation continuous plowing and accelerated soil erosion has made the production in the area to be decline.

Improper extension program: The extension support given for farmers have several limitations including lack of skill of experts and too late in provision of extension (after the farmers has implemented all activities on land). Due to this reason the productivity of the kebele in particular and Woreda in general has been declining.

Climate change: unexpected change in climate has made the decline in productivity in the Woreda. Extreme events like flood were observed in the Woreda at least once in two year.

Furthermore, the soil laboratory result indicated that the soil in the area was strongly acidic. Therefore, the acidity of the soil is one of the main factors which limit the productivity in the area.

4.3.2. Livestock production

The production of animal husbandry is also well practiced by all farmers in the Woreda. Cattle, sheep, goats, poultry, horse, mule and donkey were among animals raised for both source of food and sell.

Table 4.11: Livestock Production

Livestock	Intervention area		Non intervention	
	Number	TLU	Number	TLU
Cattle	22920	22920	14876	14876
Sheep	5017	652.21	3938	511.94
Goat	4520	588	3157	410
Poultry	12582	163.57	8904	115.75
Horse	1330	1463	365	401.5
Donkey	85	59.5	37	25.9
Mule	836	919.6	149	163.9
Total	47290	26765	31426	16505

Source: CWARD, 2012

As presented in Table 4.11, the livestock population in the intervention area was higher than the nonintervention one. Similarly, the total livestock unit (TLU) of the livestock population in the intervention area (26765 TLU) is greater than the nonintervention one (16505 TLU) (Table 4.11). As all focused group participants and key informants have mentioned, the SLMP has contributed to livestock management in its intervention area by providing fodder seedlings. This result is consistent with findings of Tesfaye Habtamu (2011), he found out that the availability of fodder due to the intervention has contributed for better livestock production in Dijjil and Lenche-Dima catchments.

However, the care given for livestock health is not as much as high. According to the Woreda Agriculture and Rural Development reports of (2012), there was shortage of skilled man power in the sector of animal health services. Because of this, a few experts in this field have the duty to cover at least three kebeles which is time consuming and tedious task. Besides, according to the key informants' information, the procurement of medicine and health care equipment took long process and hence it made difficult for the experts to provide appropriate health care for livestock in the area. In spite of these limitations, SLMP has contributed for the improvements of livestock production in its intervention kebeles.

4.3.3. Loan and loan system

The household survey result indicated that all farmers in the study area have the chance to take loan from government sectors like Omo Micro Finance. However, due to afraid of

the interest rate of loan and lack of skill in finance management, farmers in the Woreda have been rejecting the request to take the loan. While, the informants stated that the training given to the farmers through agricultural extension program by SLMP has made the community to open their door for loan.

Table 4.12: Respondents response for questions related to loan

Questions	Response Category	Intervention Respondent (%)	Non intervention Respondent (%)	χ^2	p-value
Do you have chance to get loan?	Yes	100	100		
	No	0	0		
Did you get loan?	Yes	72	18	58.91***	0.000
	No	28	82		
Do you have Credit?	Yes	26	14	10.125***	0.000
	No	46	4		
Do you have capacity to pay the credit?	Yes	23	9	3.324**	0.034
	No	3	5		

***and *** means significant at 5% and 1% probability levels respectively*

Source: Household Survey, 2013

The household survey result showed that 72 % of the respondents in the intervention area were given loan from government which was four times more than the nonintervention area (Table 4.12). The Chi-square test result presented in Table 4.12 depicted that significantly higher proportion of community members in the intervention area have gotten loan than the nonintervention one. The respondents who received loan have appreciated the SLMP contribution in raising awareness creation in financial management. The focused group participants also proved that the higher proportion of people who had got the loan from finance sector were due to awareness created by the SLMP. Moreover, the chi-square test result presented in Table 4.12 shows that there was significant variation in having credit at the time of interview with them for this study. This also assured that greater proportion of community in intervention area took loan than the non-intervention one. The same survey result also assured that there was significant difference in the capacity to pay for credit, and higher proportion of loan users in intervention area have the capacity to pay than the nonintervention one (Table 4.12).

The household survey result depicted that 79.2% of loan in the intervention area was taken for investment purpose, while 20.8% was for construction of house. Similarly, 61.5 % and 38.5% of loan in the nonintervention area was offered for investment and house construction purpose respectively. These figures also indicated that higher proportion of communities in the intervention area was engaged in investment than the nonintervention one. This result is coherent with the Shah et al. (2004) study in India. The watershed management projects were effective credit delivery system in India.

4.3.4. Employment opportunities

Besides to awareness creation, SLMP has made the job opportunities for the community members in the area. The household survey demonstrated that the SLMP has created job opportunity for 16 % of respondents' family member in its intervention area. The employed family members were engaged in watershed management as community facilitator and daily workers. During focused group discussion, the participants raised and agreed that the job opportunity created for local people in the area has contributed a huge role to the beneficiaries. Similarly, Shah et al. (2004) have found out that the watershed development programs in India have created the job opportunities for the local communities in the area. As a result, most employed members improved their lives. For example, they changed their house from hut (grass roof top) to modern iron sheet roof (see Plate 4.3).



Plate 4.3: Typical houses and their homestead in the study area

Source: Field Survey, January 2013

4.4. Social Interaction in Watershed Management

4.4.1. Community Participation in Watershed Development

Evaluating the status of the overall community participation in the intervention plays an essential role in ensuring the effectiveness of the watershed management. This is because the development intervention is intended for people and developed by the people. The participation index calculation results of the respondents were presented in Table 4.13.

Table 4.13: Participation index (PIi) of the individual respondent

PIi	Frequency	Percent	Cumulative percent
0.00	17	17	17
0.2	16	16	33
0.4	7	7	40
0.6	60	60	100

Source: Household survey, 2013

As shown in Table 4.13, 17 % of the respondents have scored the participation index value of 0.00 which means that they didn't participate in any activities of the watershed management intervention. Moreover, the result in Table 4.13 depicted that all respondents have the participation index value of less than 0.6. This indicates that the respondents participated in less than 60% of the intervention activities.

Furthermore, determination of the overall community participation would give the compressive picture about the status of participation in the catchment. Accordingly, the overall participation index of the community in the watershed management was 0.42. This shows that the community did not participate in the majority (58%) of project activities. The result of this study is similar to the findings of Singh et al. (2010) in India and Azmeraw Ayehu (2010) in Chemoga watershed of Amhara regional state. They found out that the community participation in the watershed management was poor.

Furthermore, the respondents evaluated the regularity of their participation in watershed management and development. The results of the rating are presented in Figure 4.3.

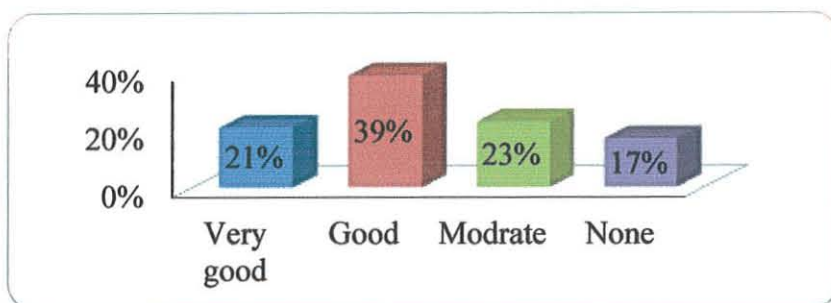


Figure 4. 3: Regularity of the respondents' participation in watershed management

Source: Household survey, 2013

As shown in Figure 4.3, 39(39 %) of total respondents in watershed management intervention area classified regularity of their participation as a good condition. Similarly, 23(23%) and 21(21 %) of respondents classified the regularity of their participation as moderate and excellent respectively. The remaining 17(17 %) of the respondents were not totally participated in the watershed development program.

During focused group discussion, the participants raised several complains in watershed management and community participation in their respective catchment. They complained that the strategy of watershed management for the area has come from the donor of the project and the communities didn't participate right from beginning. Due to this reason, it was taken several years for the project /SLMP/ to create awareness rather than implementing the program. Moreover, the community participation in project evaluation and monitoring wasn't adopted. Due to this reason, the overall participation status of the community is less than the average (50%).

4.4.2. Women Participation in Watershed Management

The active involvement of women in watershed management is vital for effectiveness of watershed management. The assessment results of this study on women participation in watershed management were presented in Table 4.14.

Table 4.14: Participation index (PIi) of the women

PIi	Frequency	Percent	Cumulative percent	Overall women participation index
0.00	32	32	32	0.206
0.2	33	33	65	
0.4	35	35	100	

Source: Household Survey, 2013

The result presented in Table 4.14 shows that the overall participation of women is limited to only 20.6% of watershed management activities. This means that the participation status of women in watershed management of the area is inadequate. The findings of this study is similar with Singh et al. (2010) and Azmeraw Ayehu (2010) findings. The key informants and focus group discussion members stated that culturally, the task of women is working in the home rather than in the field activities. Therefore, culture implication is the main reason for low status of women participation in watershed management. Azmeraw Ayehu (2010) has found the similar reason in Chemogo watershed.

4.4.3. Determinants of Community Participation in Watershed Management

As discussed above, the household survey result depicted that the overall community participation status in watershed management was found poor. Therefore, identification of the most determinant factors of participation is feasible. As most literatures manifested that age, sex, education, family size, land size, soil fertility, training and punishments would affect the status of community participation in watershed management (Aklilu Amsalu, 2006; Azmeraw Ayehu, 2010; Tadele Mamo, 2011). Accordingly, the following assumptions/hypotheses about the determinants of participation were tested.

Sex: The evidences assured that males are more participants than female in watershed management intervention. Therefore, Variation in sex is expected to have negatively or positively affects the participation.

Age: The older people have experience in farming system and hence positive relationship in participation of watershed management. On the other hand, the young people are strong and active for participation. Therefore, it is expected that the effect of age on participation in watershed management would be positive or negative.

Family size: If the household have a large number of family sizes, the labor force is cheap and the chance to participate in watershed management increases. Therefore, it is expected that the larger family size have positive relationship with participation.

Education: education increase knowledge and awareness about resources management. Therefore, education is expected to have positive relationship for participation in watershed management.

Training: Training increases the awareness and then positively affects the farmers' participation in watershed management.

Land size: The larger land size is suitable for SWC practices and has positive relationship with participation (Aklilu Amsalu, 2006). On the other hand, more land may reduce the need to conserve the land resources (Croppenstedt et al., 2003). Therefore, the land size could have negative or positive effect on participation in watershed management.

Land fertility: Farmers who own fertile land are reluctant to participate in watershed management. Therefore, land fertility is to have negative relationship with participation.

Punishment: The presence of punishment for absence in the program increases farmers' participation. Therefore, punishment is expected to have positive effect on participation.

In order to identify the determining factors of participation in Chena Woreda, the logit model was used. Before undertaking regression, checking the multicollinearity problem (association between explanatory variables) between the variables and then testing the model fitness are very important.

Multicollinearity and Model fitness

The Variance Inflation Factor (VIF) technique and Contingency Coefficient(C) are widely used to detect the problem of multicollinearity for contingency and discrete variables respectively (Gujarati, 2004). If the value of VIF is greater than 10, it is an indicator for the presence of multicollinearity problem among the variables. Moreover, if the value of contingency coefficient is also greater than 0.75, it is an indicator for the

existence of multicollinearity problem. Accordingly, test result depicted that all explanatory variables have no multicollinearity problem. Hosmer and Lemeshow test was used to test model fitness. This principle suggest that the model is adequate in prediction if the significance level is greater than 0.05. Accordingly, the model is adequate in this specific case.

Table 4.15: Results of binary logistic regression

Independent variables	B	S.E.	Wald	Sig.	Exp(B)
Sex of respondent	2.675	0.817	10.729	0.001***	14.510
Age of respondent	0.003	0.033	0.006	0.937	1.003
Education of the respondent	0.292	0.766	0.145	0.703	1.340
Family size	0.142	0.203	0.485	0.486	1.152
Land size	0.135	0.278	0.235	0.628	1.144
Soil Fertility	-0.349	0.518	0.452	0.501	0.706
Punishment	2.160	0.831	6.757	0.009***	8.668
Training	3.372	0.779	18.726	0.000***	29.125
Constant	-5.842	3.016	3.753	0.053	.003
Hosmer and Lemeshow test	0.766				

*** means significant at 1% probability

Source: Household survey, 2013

The binary logistic regression result in Table 4.15 depicted that the sex, punishment and training were statically significant variables that determine the community participation in watershed management.

Difference in sex has statistically significant effects on participation of watershed management. As presented in Table 4.15, the odds of males being participated in watershed management are 14.51 times greater than for females. Similarly, the odds of punishment presented in Table 4.15 indicated that the presence of punishment would probably increase the status of participation by 8.67 times greater than no punishment. Moreover, by having training on watershed management, the probability of farmers to participate in the intervention was increased by the factor of 29.125. This result is consistent with the findings of Azmeraw Ayehu (2010).

4.4.4. Social Cohesion and Community Acceptance of Watershed Management

The household survey result reflected that the majority of the communities in the watershed management intervention area acknowledged the significance of watershed development and management for the community (Table 4.16).

Table 4.16: Perceptions of the respondents about the significance of watershed management for unity in the catchment

Variable	Response	Percent
Harmony in watershed?	Yes	72
	No	28
Coordination among community?	Yes	66
	No	34
Resilience between upstream and downstream users?	Yes	61
	No	39

Source: Household Survey, 2013

The results of focused group discussion showed that the watershed management intervention has consolidated a lot for the unity of the community in the area. The teachings of the program in benefit sharing and respecting each other have made viable contribution for the social integrity. The key informants also stated that the rules and regulations of watershed management of the area have brought a good integration between upstream and downstream resource users.

The participants of the household survey stated the purpose of their participation in watershed management. Accordingly, the majority of respondents (70 % of the 100 respondents) said that they participated because they understood that the watershed management has a good role in sustainable land management and socio economic development. Similarly, 2% of 100 respondents participated because they directly benefited from the program. On the other hand, 11% of total respondents in watershed management area participated for fear of punishment imposed. The participants of focused group discussion proved that the value of watershed management for community development is indispensable. The key informants also stated that the watershed management intervention through SLMP play a significant role for the community development.

Therefore, the majority (72%) of community members have appreciated and accepted the importance of watershed management intervention for the community. However, as discussed above the participation of the community was poor.

4.4.5. Migration

Through household survey, the respondents were requested to answer whether there is out migration or in migration in their family members. The descriptive statistics of the responses result is presented in Table 4.17.

Table 4.17: Respondents response for the presence of migration in their family

Variable	Response Category	Intervention Amount of respondent	Non intervention Amount of respondent	χ^2	p-value
Out-migration	Yes	37(37%)	68(68%)	19.268***	0.000
	No	63(63%)	32(32%)		
In- migration	Yes	13(13%)	10(10%)	0.442	0.253
	No	87(87%)	90(90%)		

*** means significant at 1% probability level

Source: Household survey, 2013

The household survey result in watershed management intervention revealed that 37% of the respondents' family member was out-migrated, while 13% of respondents in the same catchment received the in-migrants. Similarly, the same survey in nonintervention area depicted that 68% of respondents family member were out-migrated. On the other hand, 10% of respondents in nonintervention area received in-migrants (Table 4.17).

The chi-square test result in Table 4.17 depicted that the rate of out-migration in intervention area was significantly less than the nonintervention one. This implies that the watershed management intervention has played a positive role in reducing the frequency of migration in its intervention area. This is because the program has created the job opportunity for community members. The result of this study is consistent with Singh et al. (2010). They found out that the rate of migration was reduced since employment opportunities were created to the intervention catchments of India.

Results from the household survey, focused group discussion, in-depth interview and key informants interview showed that the main reason for out-migration in the areas was decline in productivity and lack of income source. Therefore, the community members were forced to go to other places in order to secure their income sources.

4.5. Institution in Watershed Management

4.5.1. Structural Arrangement of Institution in the Watershed Management

The structural arrangement of watershed management institution in the study area has comprised several people at different stages. The members include focal person at Woreda level, community facilitator, kebele leaders, watershed management team and communities at kebele level. The responsibility and duty of each representative is discussed as follows.

Focal person of watershed management: There is one focal person at Woreda level. The focal person is the responsible for watershed development and management in the Woreda. He/she has the responsibility of regulating and controlling the activities going on in the watershed management intervention kebeles. The focal person has the duty to report the activities performed to Woreda Agriculture and Rural Development office regularly.

According to the Woreda rules and regulations (by law of Woreda) the focal person is assigned by the Woreda councils (representatives of Woreda government). The currently acting focal person was requested to give his view about his skill, knowledge, background field of study and his position in general. Accordingly, he admitted that he wasn't the right person for the position. His background field of study is not related to the duty of the focal person. However, he was assigned to cover the vacant position in the Woreda. The focal person has also mentioned that he has been facing challenges and problems in technical skill of soil and water conservation.

Community Facilitator: The community facilitator is one for each kebele. He/she has the responsibility of facilitating the activities in the watershed management, teaching the community for watershed development, and serve as foreman during structure

implementation. The facilitator has the responsibility of reporting the activities to the focal person monthly. Community facilitators were employed by the project. However, they were not fully devoted since the employment is on the bases of contract agreement.

Kebele Leaders: They are administrative bodies of the kebele including kebele manager, chairman of kebele, secretary of kebele and members. They have the responsibility of regulating and coordinating watershed management activities in coordination with community facilitators and experts. However, most respondents of the intervention area (71 out of 100 which is 71%) said that the local government representatives (Kebele leaders) were doing to secure their authority for long time rather than improving the communities' livelihood. The local administrative body forces the community to accept intervention programs without their own interest. The key informants of the area also stated as follows about the Kebele leaders:

You should accept any program which comes from representatives of the kebele since it is the policy of government. You are not requested to propose any things about it. If you complain the program, you are expected to be arrested and detained for several weeks without any reason. For this reasons, no one give his/ her idea about what is going on in the kebele. Even no one of the kebele representative request you to implement structures on your land. However, it is surprise that you can see the structures in your land without your concern. In order to secure the authority for several years, the representatives and their kebele members have to implement the watershed management program without any complain. Due to this reason, the kebele leaders are forcing the farmers to adopt the intervention without their interest.

The above statement of key informants revealed that the local administrative body (Kebele leaders) has limitation in strategies of program implementation.

Watershed Management Team: The teams are the community members who are elected by the community and approved by kebele leaders. Each committee contains seven members; one leader, one vice, one secretary, one youth representative, one female representative and two members. Each kebele may have several watershed management teams depending on the characteristics especially the size of catchment in the kebele. The watershed development regulations of the Woreda and guidelines of MoARD state that

the watershed management team has the responsibility of planning, coordinating, allocating and settling disputes at kebele level.

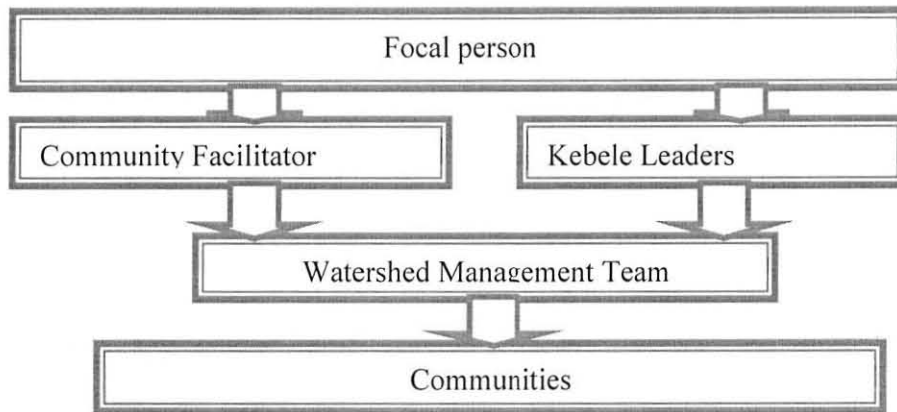


Figure 4.4: Structural arrangements of the watershed management institution in study area

Source: CWARD, 2012

As it is presented in Figure 4.4, the structural arrangement of the watershed management of the Woreda seems to be good because it was planned to include the members of the communities as its main components. However, it has several limitations. Firstly, the assigning of focal person wasn't considered technical skill, knowledge and educational background of the person. Secondly, the contract agreement between Woreda Agriculture and Rural Development and community facilitators has made the facilitators to hesitate to do the work with their maximum effort since it is only for short period of time.

The in-depth interview conducted with representatives of Woreda sectors showed that the coordination of watershed management sector with other sectors is poor. In addition, the Agriculture and Rural Development Office representatives stated that the coordination they do have with other sector was also meager.

4.5.2. Conflict and Conflict Resolution

The household survey result shows that the absence of equity and fairness for natural resources sharing among family members. Hence, it was the major sources of the conflict in the area. Moreover, the key informants stated that the issue of ownership of land resource among family members was one of the main causes of conflict in the Woreda.

Furthermore, they stated that the elite people usually secured their property right. On the other hand, the focused group discussion participants stated that the trends of having the ownership of land resources for women and minority groups (Menja) were not commonly respected in the Woreda.

Table 4.18: Respondents response for getting conflict with others

Questions	Response Category	Intervention Respondent (%)	Non intervention Respondent (%)	χ^2	p-value
Do you get conflict?	Yes	43	60	5.785**	0.016
	No	57	40		

** means significant at 5% probability level

Source: Household Survey, 2013

The majority of the total respondents (103 out of 200 which is 51.5%) assured that they faced conflict with others in natural resource sharing like grazing land, upstream and downstream water resource use competition and boarder related conflicts (Table 4.18). The household survey result also revealed that the proportion of conflict in intervention area (43 of 100 which is 43%) is less than the nonintervention one (60 out of 100 which is 60%). The chi-square test result presented in Table 4.18 also shows that the probability of getting in to conflict in intervention area is significantly lower than the nonintervention one.

The respondents in both area responded that the conflict was resolved through self-agreement, traditionally by local elders and court. In addition to the aforementioned conflict resolution mechanisms, 5(5%) of respondents in the intervention area assured that the watershed management committee has been reducing conflicts in their respective catchment through pre-prevention mechanisms i.e. preventing conflict before it happens.

Therefore, these results clearly indicated that there was better conflict management mechanism in intervention area than the nonintervention one. However, it may not be sufficient since conflict is widely occurring not only in nonintervention area but also in intervention one.

4.6. Technical Viability of Implemented SWC Structures

As the field survey result depicted, Level fanya juu, Level soil bunds, Level stone fenced soil bunds and stone bunds were implemented SWC structures in the area (Table 4.19).

Table 4.19: Implemented physical SWC structures in the area

Type of structure	Count	%
Level fanya juu	61	52.14
Level soil bund	37	31.62
Level stone fenced soil bud	17	14.53
Stone bund	2	1.71
Total	117	100

Source: Filed Survey, 2013

As the progressive report of CWSLMP (2012), indicated 6.4% of the Woreda (5777.8 hectare) was covered with the physical SWC structures. However, the same report shows that the inception plan was to cover 18035 hectare with appropriate physical SWC measures. This indicated that only 32.04 % of the plan was the accomplished. On the hand, it means that the project progress is below the expected in the plan.

The study area has Woina Dega and Dega agro-ecology (CWARD, 2012). Through considering the agro-ecology of the area, the Level fanya juu and Level soil bund are suitable for the area. However, level stone fenced soil bunds and stone bunds are not appropriate for the area. After selecting the appropriate physical structures for local agro-ecology, evaluation of its suitability for a given land use type is also an important task. Since this study is limited to cultivated land use type of the Woreda, Level fanya juu and Level soil bund are appropriate for the area. As the household survey and FAO (2008) study results show, the soil depth of the Chena Woreda ranges shallow to medium depths. Since Level Fanya Juu and level soil bunds are suitable for shallow to deep soil depths, these SWC structures are appropriate for Chena Woreda.

4.6.1. Fitness of the Physical SWC Structure Layouts with Standards

Evaluation of structures layouts mainly on length, width, depth, length of Tie ridge, height of embankment and vertical interval were conducted. This evaluation was made only on two physical SWC structures namely Level soil bund and Level fanya juu. Since

the observed sample number of Stone fenced soil bunds and stone bunds were small, layout evaluation might not give appropriate result. Moreover, as discussed above, both stone fenced soil bunds and stone bunds were not appropriate for the area. Therefore, evaluation of the design viability of these structures was not conducted.

4.6.1.1. Evaluation of the Level fanya juu Layout

Evaluation of the fitness of Level fanya juu to the standard layout of the structure was done based on the data obtained from field measurement (Table 4.20).

Table 4.20: Observed layouts of Level fanya juu

Variables	Mean (m)	SD	Test Value (m)	MD (m)	T Value	P Value
Length of Level fanya juu	9.44	0.77	10	-0.556	-5.653***	0.000
Width of the Ditch	0.46	10.16	0.5	-0.044	-3.649***	0.001
Depth of the Ditch	0.41	10.14	0.5	-0.95	-7.31***	0.000
Length of Tie ridge	0.41	10.77	0.5	-0.086	-6.243***	0.000
Height of Embankment	0.34	18.30	0.5	-0.163	-6.961***	0.000
Length of Berm	0.37	14.47	0.25	0.116	6.275***	0.000
Top Width of Embankment	0.32	0.103	0.3	0.023	1.781*	0.08
Bottom Width of Embankment	0.81	15.54	1.6	-0.793	-39.86***	0.000
Vertical interval	1.91	0.41	1.5	0.41	7.842***	0.000
Valid n	61					

* and *** means significant at 10% and 1% probability level respectively, and m means meter

Source: Field Survey, 2013

The field measurement results of physical layouts of the structures presented in Table 4.20 indicated that the observed mean length of Level fanya juu was 9.44m while it is expected to be 10 m. The mean difference was -0.556 m. The one sample t-test result showed that the observed mean difference was statistically significant. Therefore, the observed mean length of Level fanya juu was significantly lower than the standard.

The observed mean width of the ditch of Level fanya juu was 0.46 m wide (Table 4.20), while it was expected to be 0.5m. The one sample t-test results in Table 4.20 depicted that the observed mean value of the ditch width of level fanya juu was significantly lower than the standard. The results presented in Table 4.20 also showed that the depth of

Ditch, length of Tie ridge, height of Embankment, length of Berm (the distance between the mouth of Ditch and Embankment), and bottom and top width of Embankment were significantly different from the standards.

The slopes in the area ranges from 5% to 13.9% with mean slope of 7.63%. Therefore, it is expected that the vertical interval of the structure should be 1.5m. However, the one sample t-test result in Table 4.20 showed that the observed vertical interval (1.91m) of the structures was significantly higher than the standard.

Therefore, the results presented in Table 4.20 clearly indicated that the implemented physical layouts of Level fanya juu weren't in accordance with standards.

4.6.1.2. Evaluation of Level soil bunds Layout

Evaluation of the design layout fitness with the standards of level soil bund was conducted based on 37 samples which were collected through field measurement and presented in Table 4.21.

Table 4.21: Observed layouts of Level soil bund

Variables	Mean (m)	SD	Test Value (m)	MD (m)	T-value	P-Value
Length of Level Fanya Juu	9.42	0.79	10	-0.548	-4.49***	0.000
Width of the Ditch	0.45	0.12	0.5	-0.054	-2.75***	0.009
Depth of the Ditch	0.41	0.11	0.5	-0.095	-5.49***	0.000
Length of Tie ridge	0.42	0.11	0.5	-0.084	-4.80***	0.000
Height of Embankment	0.32	0.19	0.5	-0.176	-5.73***	0.000
Length of Berm	0.38	0.15	0.25	0.127	5.27***	0.000
Top Width of Embankment	0.32	0.10	0.30	0.025	1.43	0.160
Bottom Width of Embankment	0.81	0.16	1.6	-0.79	-30.1***	0.000
Vertical Interval	1.86	0.41	1.5	0.36	5.30***	0.000
Valid n	37					

*** Means significant at 1% probability level and m means meter

Source: Field Survey, 2013

The one sample t-test result presented in Table 4.21 indicated that the majority of variables of Level soil bund layouts such as length of Bund, depth of Ditch, length of Tie ridge, height of Embankment, length of Berm (the distance between the mouth of Ditch and Embankment) and bottom width of embankment were significantly lower than the standards. On the other hand, the observed mean Vertical interval was significantly

higher than the standard. However, the top width of the Embankment of Level soil bund was only constructed with the standard.

The Key informants stated that these structural layout faults come from two main sources. Firstly, the farmers' bargaining the foremen during construction of the structure because they assume that nearly constructed structures occupies their land which is useful for cultivation. Secondly, there is lack of skills. The selected foremen were the member of community and they did not get detail training on technical issues of SWC structures.

4.6.2. Diversity of SWC Structures

One cannot fit the entire syndrome. Hence, no one structure is totally suitable for given area. Therefore, the use of diversified measures in an integrated manner is crucial for better land management. Diversity of structure for this study is measured in terms of the type of structure implemented per farm lands of the individual farmer. Accordingly, 66% of the respondents revealed that one structure type per farm land plot of individual farmer was implemented, and 23 % of respondents were used two types of structure per farm land plot. The remaining one percent used three and more structure per farm plot. These figures indicated that the diversity of structure per farm land plot of each farmer land is very poor. Moreover, the diversity of physical SWC structure at Woreda level is also poor since only the aforementioned four structures were dominated in the Woreda.

4.6.3. Maintenance and Management of the Structure

Regular maintenance and management of the implemented SWC measures should be done for its sustainability in the area. However, the trends in the study area indicated that there wasn't regular maintenance and management of once implemented structures. Majority of respondents (78.6%) agreed that there was no maintenance and management activity once the structures were constructed. As the key informants' information, once the structure is constructed no one go back for its maintenance and management. The participants of all focused group discussion have also concluded that there was no regular maintenance and management of implemented structures in the area. They also confirmed that the problem wasn't only the farmers but also the Woreda SLMP focus. The Woreda SLMP has given attention mainly to the expansion of the structure. Due to this, there was

limitation in regular maintenance and management of implemented structure. Hence, during field observation the destructed structures were mainly observed in the area.

4.6.4. Timing of SWC Measures Implementation

The household survey result revealed that 50% of SWC measures were implemented during January, 22% from October to December and 28% from February to April. This survey result depicted that the majority of SWC measures were implemented at January. On the other hand, January is an intensive cultivation season for the Woreda. Hence, the SWC measures implementation program was overlapped with the intensive cultivation seasons in the area. In this regard, all respondents complained about the timing of SWC measure implementation. Moreover, all key informants and the Woreda Agriculture and Rural Development experts of Natural Resource Management had complained the timing of SWC measures implementation. The expert said that the improper timing of SWC measures implementation is due to the miss match of the Woreda growing season with other woredas of the region. The implementation calendar was come from the region (SNNPR) and therefore, the Woreda is facing the challenges in implementation program arrangements.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The watershed management intervention introduced by SLMP in Chena Woreda was effective in several aspects; meanwhile it has also the components in which the project has unsatisfactory achievements.

The findings indicated that the watershed management intervention brought about reduction in soil erosion and thereby improvement of soil fertility, water availability and quality, and development plantation forest in its intervention area. However, the soil is highly affected by acidity, the capacity to use the available water is limited and the quality of water for drinking purpose is poor in the area.

The study further disclosed that there was no significant improvement in crop production in the Woreda. However, the intervention brought an improvement in livestock production. Moreover, the SLMP introduced the strategies to diversify the income sources in the area. Hence, the communities depends not only single income source but also diversified sources like crop and livestock production. Therefore, the communities shock for poverty has been reduced in watershed management intervention areas of the Woreda. Furthermore, the SLMP has vividly contributed to the local communities' income development through creating awareness for finance management, loan systems and creating job opportunities.

The participation status of communities in watershed management was found out to be poor. The difference in gender, training and the presence of punishment are the determining factors of the participation in the area. In spite of having low motivation for participation, the acceptance of watershed management by the communities is becoming good. The intervention has contributed for reduction of migration, and increment of unity, harmony and respect among community in the catchment.

The SLMP has formulated institutions for better land resource management. The structural arrangement of the institution was participatory and has good achievements in conflict resolution. However, the technical skill, knowledge and capacity of the assigned persons in the positions were poor. Similarly, some local administrative bodies have their own interest and motives like securing authority for long period of time rather than devoting themselves for the community development through sustainable watershed management.

The watershed management intervention introduced mainly Level fanya juu and Level soil bunds in the area. The implementation progress of the structures is performing below the expected and accomplished only the limited parts of the designed targets. The introduced physical SWC structures are appropriate for the area. However, the implemented structures layouts were not in accordance with the standards. Besides to the limitation on layouts of the structures, the diversity of implemented structure was also poor. Moreover, the regular maintenance and management of implemented SWC structures were not practiced in the area. Timing of SWC structures implementation in the Woreda was also inappropriate.

5.2. Recommendations

Based on the empirical findings of the study, the following recommendations are forwarded.

- ❖ The local communities are expected to play their role in natural resources conservation like improving soil acidity through liming, preventing water pollution by fencing and protecting the entrance of animals, and conserving forest resources.
- ❖ The SLMP is expected to develop the skill, knowledge and capacity of focal person, community facilitators, kebele leaders, watershed management teams and the communities in relation to watershed management through capacity building.
- ❖ The government should secure the ownership of natural resources for the local communities through certification within the family members.
- ❖ The SWC structures are expected to be implemented in accordance with the standards. Therefore, it is advisable that the project to implement structures according to the standard layouts. The intervention should use a diverse SWC measures. Regular maintenance and management of the structures should be in the place. Moreover, the appropriate time of the SWC for the local situation is expected to be identified and used for the further implementation.
- ❖ Furthermore, interdisciplinary study for better development of the project is recommended to be done in the same study area or elsewhere in the country to provide empirical evidences for the country situation.

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APPENDICES

Appendix 1: Frequency of Soil Laboratory Result

A.1.1. Frequency of soil laboratory result for Intervention Site

TN (%)		OC (%)		Ava. P(ppm)		PH H ₂ O			
Value	Freq	Value	Freq	Value	Freq	Value	Freq		
2.67	6	3.10	1	0.27	12	12.00	9	4.49	6
2.70	1	3.30	1	0.28	6	12.80	4	4.52	1
2.80	4	3.32	4	0.29	7	13.00	4	4.54	4
2.84	1	3.34	1	0.3	1	13.60	1	4.56	1
2.85	1	3.43	1	0.32	2	14.00	4	5.00	5
2.86	2	3.44	1	0.33	1	14.20	1	5.16	2
2.87	1	3.45	2	0.34	3	14.40	3	5.17	6
2.88	1	3.46	1	0.35	5	14.80	8	5.24	2
2.90	1	3.47	1	0.36	2	15.00	2	5.27	6
2.92	1	3.50	1	0.37	3	16.00	2	5.32	2
2.94	1	3.51	4	0.38	4	17.00	2	5.34	4
2.96	2	3.52	1	0.39	8	18.00	2	5.48	2
2.97	1	3.80	2			28.40	1	5.59	6
2.98	2	3.84	2			28.60	4	5.68	1
2.99	2	3.88	2			28.80	1	6.63	6
3.00	2					46.4	6		

A.1.2. Frequency of soil laboratory result for nonintervention site

TN (%)		OC (%)		Ava. P(ppm)		PH H ₂ O			
Value	Freq	Value	Freq	Value	Freq	Value	Freq		
0.18	6	1.43	7	8.60	6	26.6	4	4.73	8
0.20	6	2.20	1	14.00	1	26.8	1	4.75	2
0.22	12	2.21	2	14.80	4			4.77	4
0.29	6	2.22	1	15.60	2			4.78	2
0.36	6	2.65	1	16.20	6			4.79	2
0.39	18	2.67	4	16.40	2			4.96	6
		2.69	1	16.60	2			5.20	1
		2.82	2	16.80	1			5.21	1
		2.86	2	19.00	1			5.22	4
		2.99	7	19.40	4			5.23	4
		3.00	2	19.80	1			5.24	2
		3.25	6	21.20	2			5.32	1
		3.62	2	21.60	2			5.36	4
		3.64	2	21.80	6			5.38	1
		3.66	2	22.00	2			5.40	6
		3.71	6	25.80	6			5.70	6
		4.32	6	26.40	1				

Source: Laboratory result, 2013

Appendix 2: Frequency of Water Laboratory Result

A.2.1. Frequency of water laboratory result for intervention site

PH		Conductivity($\mu\text{s}/\text{cm}$)		Temperature($^{\circ}\text{C}$)		Fecal coliforms(no.)	
Result	Freq	Result	Freq	Result	Freq	Result	Freq
7.1	2	25	1	17.9	1	2	1
7.2	1	27	3	18	3	3	1
7.3	2	28	2	18.8	2	5	3
7.4	2	29	5	18.9	1	10	4
7.5	1	30	3	19	2	12	1
7.6	4	30.4	2	19.5	1	15	1
7.65	1	30.8	1	19.6	1	20	3
7.7	1	31	1	19.8	1	25	2
7.74	1	31.3	1	19.9	2	30	7
7.8	4	32	3	20	4	40	1
7.84	2	33	3	20.2	1	60	1
7.85	1	36	2	21	3	100	2
7.9	1			21.3	1		
7.93	1			22	2		
7.96	1			23.1	1		
8.2	1						
8.3	1						

Po ₄ (PPM)		NO ₂ ⁻ (mg/l)		NO ₃ ⁻ (mg/l)		Ammonia (mg/l)		Turbidity(NTU)			
Result	Freq	Result	Freq	Result	Freq	Result	Freq	Result	Freq	Result	Freq
0.4	3	0.3	12	0.4	3	0.4	3	10	1	22	1
0.5	1	0.4	6	0.5	3	0.5	3	12	1	23	1
70.6	9	0.7	3	0.6	3	0.6	3	15	1	24	3
0.7	4	1.2	6	0.8	12	0.8	12	17	3	25	1
0.8	6			1	6	1	6	18	2	26	3
0.9	2							19	3	29	1
1.0	2							19.5	1		
								21	4		

Source: Laboratory Result, 2013

A.2.2. Frequency of water laboratory result for nonintervention sites

PO ₄ (ppm)		NO ₂ ⁻ (mg/l)		NO ₃ ⁻ (mg/l)		Ammonia (mg/l)		PH	
Result	Freq	Result	Freq	Result	Freq	Result	Freq	Result	Freq
0.4	3	0.4	6	4	3	0.5	6	7.1	1
0.5	1	0.5	6	7	3	0.8	15	7.6	2
0.55	1	0.6	6	10	6	1	6	7.7	1
0.6	6	0.9	3	12	3			7.8	2
0.7	6	1.2	6	13	3			7.9	5
0.8	5			15	6			8	1
0.83	1			20	3			8.1	6
0.9	2							8.2	6
1	1							8.24	1
1.1	1							8.3	2
Conductivity((μs/cm))		Temperature(°C)		Turbidity(NTU)		Fecal Coliforms(no.)			
Result	Freq	Result	Freq	Result	Freq		Result	Freq	
35	1	17.9	1	12	1		0	3	
36	1	18.4	1	15	1		2	1	
39	1	18.8	1	17	1		5	2	
39.5	1	19.5	2	18	1		50	1	
41	1	19.6	1	19	2		56	1	
45	2	19.9	1	21	5		60	1	
47	1	20.1	2	22	4		63	1	
47.3	1	20.5	1	23	1		69	1	
48	1	21	3	25	5		70	1	
49.2	1	21.1	1	26	1		80	2	
51	1	21.5	1	28	1		85	1	
51.6	1	21.6	1	29	2		90	1	
52	1	22.3	1	30	1		96	1	
53	1	23	1	35	1		99	1	
55	2	23.1	1				100	2	
56	1	23.2	1				110	2	
57.5	2	23.3	1				120	1	
58	1	23.4	1				125	2	
59	1	24.4	2				130	1	
61	1	24.5	2				205	1	
62.8	1	25	1						
31.1	1								
72.7	2								

Source: Laboratory Measurement, 2013

Appendix 3: Conversion Factors Used to Estimate Tropical Livestock Unit (TLU)

Livestock types	TLU equivalent
Cow and oxen	1.00
Horse/mules	1.10
Donkeys	0.70
Heifers/bulls	0.75
Calves	0.25
Sheep/goats	0.13
Chicken	0.013

Source: Strock *et al.* (1991) cited in Tadele Mamo (2011)

Appendix 4: Conversion factor used to estimate the level of scales in the paper

Scales	Score out of 5
Excellent	5
Very good	4
Good	3
Moderate	2
Poor	1
None	0

Appendix 5: Standard Layouts of Level Fanya Juu and Level Soil Bunds Used in this Paper

Variables	Level Fanya Juu	Level Soil Bunds
Length	10m	10m
Width of the Ditch	50cm	50cm
Depth of the Ditch	50cm	50cm
Length of Tie ridge	50cm	50cm
Height of Embankment	50cm	50cm
Length of Berm	25cm	25cm
Top Width of Embankment	30cm	30cm
Bottom Width of Embankment	1.6m	1.6m
Vertical interval	1.5m	1.5m

Source: Hurni, 1986; Lakew Desta *et al.*, 2005

Appendix 6: Questionnaires for Household Survey

Addis Ababa University
College of Development Studies
Center for Environment and Development
Department of Water and Development

Dear sir/ madam

The objective of this questionnaire is to collect primary data environmental, socio-economical, instructional and technical related information that are required to the effectiveness of watershed management intervention in Chena Woreda, Kaffa Zone Southwestern Ethiopia. Therefore, you are kindly requested to give your response freely and accurately to the success of this study. Dear respondents, you should be confident that the data/information which you give works only for the study of partial fulfillments of Masters Degree in water and Development.

Lastly, I thank you for your cooperation

Name of data collector _____ Date _____

A. General information

Name _____, sample number/code _____ sex _____ Age _____,

Kebele _____, village _____ Agroecology _____

Family size: Male: _____, Female _____, Total _____

Marital status: a) married b) single c) divorced d) other _____

Education status: a) illiterate b) grade 1- 4 c) 4-8 d) 9-12 e) above grade 12

How long do you residence in the kebele? _____

Your main responsibility in family _____

B) Questions related to Environmental issues

1. Do you have land? a) Yes b) no
2. If you say yes for question 1, what is the size of your land in hectare? _____

3. How is the status of the soil fertility of your land? a) fertile b) moderate c) poor
4. What are the criteria's you used to rate the status of your land fertility?

5. Do you have SWC measures in your land? a) yes b) no
6. What effect do you see on soil fertility of your land after watershed management intervention? a) it improved the soil fertility b) it decline soil fertility c) no change
7. Is your land productivity increasing or decreasing since you have started watershed management interventions? a) increasing b) decreasing c) no change
8. If the productivity of your land has been increasing, what are the mains reasons for the increment of land productivity? _____
9. If the productivity of your land has been decreasing, what are the main reasons for the decline of you cultivated land productivity? _____
10. What are the main sources of water in your locality? a) river b) spring c) pipe water d) Pond water e) other _____
11. How is the quality of the water in your locality? a) good b) moderate c) poor
12. What are the criteria's you used to rate the status water quality in your locality?

13. Do you believe that watershed management intervention has effect on water quality in your locality? a) yes b) no
14. If you say yes for question 13, what effect you see in your locality? a) improving water quality b) declining water quality c) no change
15. Do you get sufficient water for you and your family needs daily? a) yes b) no
16. How long your family member travel to fetch water (estimate minute)?

17. Does watershed management intervention have effect on the improvements of water availability in your locality? a) yes b) no
18. If you say yes for question 17, what effects you see on water availability? a) improving water availability b) declining water availability c) no change
19. Do you have forest/ tree on your land? a) yes b) no
20. If you say yes for question 19, estimate the amount of tree stocks in number _____

21. Are you planting trees in your land regularly in annual base? a) yes b) no
22. Where do you get the tree seedlings a) from my own nursery site b) from public nursery site c) from both sites
23. Is there public owned natural forest in your locality? a) yes b) no
24. Do you belief that it belongs to you? a) yes b) no
25. If you say yes for question 24, how _____
26. If you say no for question 24, why _____

C) Questions related to households income

1. What is your income source? a) agriculture b) merchant c) government employment d) other _____
2. If you say agriculture for question 27, which agricultural activities? a) Crop production b) livestock production c) mixed farming
3. If you used crop production, please fill the following table

Type of crop produced	Size of land used in hectare	Products (Quintals , 100kg)

4. Do you plant different crops on your land at the same time in the same plot? a) yes b) no
5. Do you plant crops sequentially on your land? a) yes b) no
6. Please list and explain the land management practices you used on your land traditionally _____
7. If you used livestock production, please fill the following table

Type of animal	Size in number	Their feeding source
Ox		
Cow		
Sheep		
Goat		
Horse		
Mule		
Donkey		

8. What is the main source of fodder for your livestock? a) Own private grazing land
b) communal grazing land c) crop residue d) buying fodder e) other _____
9. Does the presence of SLMP help you to improve the fodder sources for your livestock production? a) yes b) no
10. Do you have the opportunity to take loan from government? a) yes b) no
11. If you say for question 36, did you get loans? a) yes b) no
12. If you say yes for question 37, did SLMP help you in getting loan? a) yes b) no
13. If you say for question 38, How _____
14. For what purpose did you used the loan given to you? _____
15. Currently, do you have loan credit? a) yes b) no
16. If you say yes for question 41, do you have the capacity to pay it? a) yes b) no
17. If you say no for question 42, what measure the government will take on you?

18. If you say no for question 42, what measures are you deciding to pay it?

19. Did your family members have job opportunity due to SLMP? a) yes b) no
20. If you say yes for question 45, in which activity he/ she engaged? a) community facilitator b) daily worker c) other _____
21. If you say yes for question 45, for what purpose did he/ she used the salary?

D) Questions related to Social issues

1. Do you belief that watershed management is vital for your locality? a) yes b) no
2. Do you support the watershed management project in your locality a) yes b) no
3. Did you take training in watershed management? a) yes b) no
4. Do you participate in watershed management project in your locality? a) yes b) no
5. If you say yes for question 50, in which phases of project you participated? You can choose more than one a) problem identification b) implementation c) monitoring and evaluation

6. How do you evaluate the regularity of your participation? a) very good b) good c) moderate d) poor
7. What makes you to participate in watershed management? a) I understood the aims of program and interested to participate b) I am forced by local leaders and afraid of punishment c) other _____
8. Did women equally participate in watershed management? a) Yes b) no
9. Did women make decision in landuse planning? a) Yes b) no
10. Did women equally share natural resources? a) Yes b) no
11. Did women equally get training? a) Yes b) no
12. How do you evaluate the overall participation of women in watershed management a) excellent b) very good c) good d) moderate e) poor
13. Is there migration in your locality? a)yes b) no
14. Do you have your family members emigrated? a)yes b) no
15. Did you receive immigrant as your family member? a)yes b) no
16. What was the main cause of emigration for your locality?

17. Does watershed management created harmony within the community? a) Yes b) no
18. Does the intervention created coordination among the community? a) Yes b) no
19. Does watershed made resilience between upstream and downstream resource users? a) Yes b) no

E) Questions related to Institutional issues

1. Do you share natural resources with others a) yes b) no
2. Do you consider the others need/ want in your resource utilization? a)yes b) no
3. Did you get conflict with other in relation to natural resources sharing a)yes b) no
4. If you say yes for question 3, how did you solve conflict _____
5. Is there watershed management committee in your locality? a)yes b) no
6. If you say yes for question 5, who elect them _____
7. Did the watershed management committees are interested to work together? a)yes b) no
8. How do you evaluate the commitment of the watershed management committees for betterment of the catchment? a) highly committed b) committed c) moderate d) poor e) other _____
9. Did the watershed management project respect the interest of stakeholders? a)yes b) no

F) Questions related to Technical issues

1. Do you have SWC structure on your land implemented by watershed management project? a)yes b) no
2. If you say yes for question1, which is it? a) Level soil bund b) graded soil bund c) level fanya juu d) graded fanya juu e) water way f) micro basin g) terraces h) other _____
3. Can you construct the SWC structures by yourself? a)yes b) no
4. If you say no for question1, who constructed it on your land? a) Experts b) community facilitator c) community e) daily worker f) other _____
5. At which month the SWC structure implemented on your land? _____
6. Did you take training about SWC measures construction? a)yes b) no
7. Please fill the following table by using field measurement on the physical layouts on implemented SWC measures.

Name of structure		Length of berm (M)	
Length of bund (M)		Spacing (M)	
Width (M)		Bottom width of embankment (M)	
Depth (M)		Top width of embankment (M)	
Slope (%)		Management	
Length of Tie ridge(M)		Maintenance	
Height of embankment (M)		Other	

8. What challenges did you face during implementation of Physical SWC measures?

9. What challenges did you face after implementation of Physical SWC measures?

10. what measures did you take to overcome the challenges you faced
 - ❖ During implementation _____
 - ❖ After implementation _____
11. Please give your comment on overall watershed management intervention project _____

Appendix 8: Checklists for key informants interview and focused group discussion

1. Evaluate soil fertility and land productivity in your catchment
2. What effects was observed on soil fertility and land productivity due to watershed management?
3. Evaluate water quality and quantity in your locality.
4. What effects do you see on water availability and quality due to watershed management?
5. Discuss about forest resources and natural resources sharing in your locality
6. What are the main income sources in your locality?
7. What are the major land management practices adopted traditionally by farmers. Discuss their advantages and disadvantages.
8. How do you see the loan and loan management in your locality?
9. What has the contribution of SLMP on loan uses in your locality?
10. How do you see community participation in watershed management?
11. How do you see migration in your locality?
12. How do you see the watershed management committees?
13. Discuss about cases conflict in your locality. Consider cause, effect and ways to resolve conflict

Appendix 9: Checklist for Field Observation

- ❖ Soil erosion and land degradation _____
- ❖ Distribution of settlements _____
- ❖ Crop Patterns _____
- ❖ How do you evaluate livestock productivity and grazing land _____
- ❖ Farmers land management activities _____
- ❖ Water resources potentials _____
- ❖ Water sources protection systems _____
- ❖ Forest cover in individuals' land _____
- ❖ Natural forests in the catchment _____
- ❖ SWC measures implemented _____
- ❖ General evaluation on SWC structures _____
- ❖ Over all land use system in the catchment _____
- ❖ Land covered with soil and water conservation structure _____
- ❖ Female's involvement in daily farm land management activity? _____
- ❖ What you observe social interaction in the area? _____
- ❖ What do you observe in relation to youth job opportunity? _____
- ❖ Put your overall comment field observation condition _____

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university, and all sources of material used for the thesis has been duly acknowledged.

Name: Yericho Berhanu

Signature:  _____

Date: June 18, 2013