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IMPACT OF INTEGRATED WATERSHED MANAGEMENT PROGRAM ON FOOD SECURITY: THE CASE OF MAI ZEG ZEG WATERSHED IN DEGUA TEMBEIN WOREDA OF NORTH ETHIOPIA

By

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF ARTS DEGREE IN DEVELOPMENT STUDIES (RLDS)

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Declaration

This is to certify that this thesis entitled **"Impact of an Integrated Watershed Management Program on Food Security: The Case of Mai Zeg Zeg Watershed in Degua Tembein Worada "** submitted in partial fulfillment of the requirements for the award of the degree of MA., in Development Studies to the College of Business and Economics, Mekelle University, through the Department of Management, done by Mr./Ms. **Sebhatu Seyoum Halibo,** Id.No **FBE/PR 0017/00** is an authentic work carried out by him/her under my guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of my knowledge and belief.

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Abstract

The government of Ethiopia and the supporting donors have been investing huge resources on the food security programs though the watershed management approaches elsewhere in the country and the study woreda in particular. However the impact of such programs was not systematically studied. Without knowing the impact of watershed management food security programs mere implementation cannot guarantee positive outcome.

This study was conducted in Degua Tembein woreda ,a food insecured area of the regional state of Tigray .It attempts to assess the impact of the integrated watershed management program on food security in the Mai Zeg Zeg watershed of Degua Tembein Woreda. The watershed based program impact is assessed in terms of household income, environment and water coverage and related indicators. A combination of quantitative and qualitative research methods were employed. As part of quantitative and qualitative research methods, primary data were collected by means of household survey questionnaire and focus group discussions respectively. As a tool of analysis descriptive analysis and propensity score matching were used. A total Sample of 200 respondents were randomly selected out of which 100 were program participants from Tabias of Aynimbrikekin and Michealaby (treated group) and 100 were non participants from Adiazemera Tabia (untreated) .

The study results show that the watershed based food security program in the Mai zeg zeg watershed has shown significant impacts in terms of household income, environment and water coverage and related indicators. In figurative terms the program participants have enjoyed an average annual gain in the total household income between ETB 566.170 and ETB 340.098. With regard to production gain the households benefited with an average production gain in total production per tsimidi between 2.418 and 0.65 quintals. In terms of the number of months a household can feed his family, on average the participants have gained a benefit of feeding their families for extra months between 0.600 and 1.620. The study finding on the average livestock holding showed that program participants have not made any significant gain.

The second most important issue that this study tried to assess is that the impact of the program on the environment. The study findings showed that there are two major benefits gained from the natural resources management: increased vegetable coverage and increased water discharge in down streams of the constructed SWC measures. Finally the study results on water access indicated that the project participants have much better access than the non participants. To this end 93% of the project participants have responded that they have access to clean water source. On the other hand the estimated results on average time to fetch water and average number of liters a household consumes per day showed that the non- participants need more extra time between 105.024 and 119.277 minutes. At the end the program participants have not made any significant gain on average water utilization. The results of the study showed that the Mai zeg zeg watershed management program has registered remarkable impact on the level of income, environment and water and related indicators. Therefore for the sustainability of these impacts proper policy and institutional set up of the watershed approach should be devised.

Key words: Impact, Food Security, Watershed Management, Mai Zeg Zeg.

Acronym

ADCS	Adigrat Diocese Catholic Secretariat
ADLI	Agricultural Development Lead Industrialization
ATT	Average Treatment of the Treated
BoFED	Bureau of Finance and Economic Development
CBA	Cost Benefit Analysis
CSA	Central Statistical Agency
DAP	Dia ammonium Phosphate
DFID	Department for International Development
DTWOoARD	Degua Tembein Woreda Office of Agriculture and Rural Development
DTWAO	Degua Tembein Woreda Agriculture Office
EIA	Environmental Impact Assessment
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
FSS	Food Security Strategy
GDP	Gross Domestic Product
GIS	Geographic Information System
Ha	Hectare
Kcal	Kilo calorie
LDC	Less developed country
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development

MEDAP	Ministry of Economic Development and Cooperation
MZZIWMP	May Zeg Zeg Integrated Watershed Management Project
NGO	Non Government Organization
NPAoFSP	New Partnership Agenda on Food Security Progamme
OWG	One World Guide
PA	Peasant Association
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PSM	Propensity Score Marching
PSNP	Productive Safety Program
SIA	Soil Impact Assessment
Sq.Km	Square Kilometer
SPSS	Statistical Package for Social Science
SSA	Sub Sahara Africa
Std.Err	Standard Erorr
SWC	Soil and Water Conservation
TLU	Tropical Livestock Unit
TRLS	Tigray Region Livelihood Summaries
UN	United Nations
USAID	United States' Agency for International Development
USDA	United States' Department of Agriculture
WFS	World Food Summit

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CHAPTER I: INTRODUCTION

1.1. Back ground of the study

Ethiopia with an estimated per capital gross domestic product (GDP) of $160, is one of the lowest income earning countries, in the world and it is positioned 170th on the UN's Human development index list *(World Bank, 2008)* . It is one of the 47 least developed countries (LDC) as well as one of the food deficient and low livelihood nations, on top of that Ethiopia is among the top 10 countries with Lowest Human Development In**dex**. Out of the total population 73,918,505 (CSA, 2007) only 22 percent have access to safe drinking water, and only 15 percent use adequate sanitation facilities. Literacy rate stands at 49% (men); 34% (women); infant mortality rate of 77 per 1,000 live births (MoFED, 2009) and gross primary school enrolment rate was 62 percent (*World Bank, 2008)*. These are some of the indicators that show the low level of economic status of the country.

HIV/AIDS pandemic is a potential challenge to economic development. The recurrent drought the country faces has been worsening health problems such as communicable diseases. Being heavily dependent on the subsistence mode of agricultural production, almost half of the total population of the country is living below poverty line and the country is suffering from both chronic and transitory food insecurity (NPAoFSP*, 2003 P, 2)*. This indicates that the major cause of poverty in Ethiopia is food insecurity, which is primarily the result of low agricultural productivity, drought and serious land degradation. Until food security is ensured, the majority of Ethiopians will remain locked in the poverty trap. 85% of households depend on agriculture, including about 10% herding livestock, all working on land in a sector unaccountably deprived of investment. Crops are therefore almost entirely rain fed in a country synonymous with the ravages of drought. Population growth of 2.6% *(CSA, 2007)* creates added pressure. Over 7 million people are classed as chronically food insecure, largely in the

highlands where drought is most unrelenting. A further 10 million are identified as prone to drought ***(See http://uk.oneworld.net/guides/ethiopia Food Security).***

As a response, the Ethiopian government has designed the food security strategy of the country which targeted mainly to the chronically food insecure, moisture deficit and pastoral areas. A clearer focus on environmental rehabilitation as a measure to reverse the level of degradation and also as a source of income generation for food insecure households through a focus on biological measures marks a deviation from the 1996 strategy. Water harvesting and the introduction of high value crops, livestock and agro-forestry development further inform its content. In recognition that the pursuit of food security is a long-term and multi-sector challenge, institutional strengthening and capacity building is included as a central element of the strategy. As in the past, however, the overall objective of the FSS is to ensure food security at the household level, while Agricultural Development Led Industrialization (ADLI) will focus on creating the conditions for national food self-sufficiency (*FDRE, 2002**).***

The Tigray regional state is found in the Northern part of the country extending from 12° 15 - 14° 49/ North latitude to 36°27°/ - 40° 00/ East longitude. The region has an area of 53,386 sq.km (BoFED, 2003).The population of the region is growing at 3 percent every year and the current population census shows that the region has a total population of 4,314,456 million ***(****CSA 2007).*

The economy of the region is mainly dependent on agriculture and out of the total population 85 percent is dependent on agricultural sector. Almost 64.5 of the gross domestic product of the regional state derived from this sector. *(BoFED***,** 2003)

However, due to recurrent drought and the highly depleted natural resource base of the region is not getting enough production from this agricultural sector. As the agriculture of the region is rain fed under dry land environment, the rain pattern is also erratic and unreliable not only that but also the soil fertility is low, use of

improved form technology is also low. Farming systems are less integrated to markets because production hardly exceed subsistence requirement.

All these summed up and led the region to be chronic food insecurity and then to very low livelihood status. In line with the country's strategy the region is following a strategy of "Agriculture Development Led Industrialization", (ADLI) which focuses at conservation based agricultural production, small scale irrigation, and expansion of education and health facilities but with the presence of recurring drought the strategy is still facing problems instead of achievements.

To counter face the challenge of food insecutiy and come out with a food secured future the regional government is implementing various food security programs under the umbrella of the national food security strategy. The governments of Tigary region and donor agencies are implementing different food security programs on the basis of watershed approach. The watershed Watersheds have been viewed as useful systems for planning and implementing natural resource and agricultural development for many centuries (Brooks *and Eckman**, 2000).***

South eastern zone of The Tigray regional state is one of the drought affected zones of Tigray region and of course one of the food insecured zones and low level of livelihood condition, and Dogua Tembein woreda where the study conducted is found in south eastern zone of the region**.** The integrated watershed management program is implemented in Maizegzeg watershed with the objective of improving the livelihoods of the targeted households through natural resource conservation, increased agriculture productivity and production and improving the water supply of the targeted areas.

This study tries to investigate the impact of the integrated watershed management program on the food security of the targeted households in the Maizegzeg watershed of the Dogua Temben woreda.

1.2 Statement of the Problem

The major poverty related indicators of Ethiopia signal great challenges ahead for the realization of sustainable economic and social development. Poverty reduction and its ultimate eradication in all its dimensions have been and still are the overriding development agenda of the Government of Ethiopia (PASDEP, 2006). As part of the poverty reduction agenda the country has designed a food security strategy which addresses both the supply and the demand side of the food equation, that is, availability and entitlement respectively from both a national and household level perspective. The food security strategy has three main pillars which states increase the availability of food through increased domestic production, ensure access to food for food deficit households, and strengthen emergency response capabilities *(FDRE, 2002*).

Similarly the Food security program is designed to address problems of shortfalls in food production, vulnerability to falls in consumption and incomes and consequent hunger that the country has faced repeatedly, through adaptation of development alternatives to bring about lasting solution (PASDEP, 2006).

The government of Tigary region has adopted the national food security strategy to tackle the problem of food in security in the region by adopting the watershed development approach. The main causes of food insecurity in the region is manifested by low level of agriculture production and productivity which intern caused by land and natural resources degradation, population pressures , recurrent drought , limited source of alternative incomes, limitation in technology, lack of product diversification and market integration ,limited access to credit service and ,limited capacity in planning & implementation.

To tackle the problem of food insecurity and reverse the situation many development and emergency related programs and efforts have been done and are still going on by adopting the watershed management approach by the Tigary regional government and different donors agencies.

The integrated watersheds management approaches have been viewed as useful systems for planning and implementing natural resource and agricultural development for many centuries *(Brooks and Eckman 2000)**.*** Watershed management is a holistic approach which aims at optimizing the use of land, water and vegetation in an area to alleviate drought, moderate floods, prevent soil erosion, improve water availability and increase fuel, fodder and agricultural production on a sustained basis.

In order to attain sustainable food security and long lasting impact on livelihoods of the integrated watershed management programs must be combined with the efficient knowledge of the watershed management. While putting huge investment on food security programs through the watershed management approach there are many growing interest about the impact of those interventions. Especially the Ethiopian government as a general and the regional government in particular with the assistance of external donors are highly engaged in the implementation of watershed based food security programs.

By considering the good sides and negative sides of such interventions it is highly possible to avoid problems and systematically formulate relevant watershed management programs that can contribute to the food security at house hold level and national level. Despite of the huge interest on the impact study of such interventions the study made regarding these programs is limited in our country.

Therefore it will be sound using this paper to make study and investigate the impact of the concerned watershed management program in the study area and contributing to the gap of knowledge in the concerned topic.

1.3 Research Objectives

1. 3.1. Overall Objective of the Study

The overall objective of this research is to assess the impact of the integrated watershed management program on food security in the Mai Zeg Zeg watershed of Degua Tembein Woreda.

1.3.2 Specific Objectives of the Study

I. To analyze the house hold level impact of the program on the participant as a result of the interventions. i.e *level of income*
II. To analyze the impact of the interventions on the natural resource rehabilitation .i.e. *environmental impact*
III. To investigate the level of water coverage and its related impact.
IV. To investigate the problems associated with the watershed management approach and their solution.

1.4. Research Questions

1. What is the level of income for the program participants and non participants?

2. What is the current level of land productivity of the treated and untreated areas?

3. Does the conservation of natural resources accompanied with economic gains?

4. What is the level of water coverage and its related impact on water borne disease?

5. What are the major problems associated with the watershed management and what type institutional arrangement is needed?

1.5. Scope of the Study

The scope of the study is limited to the Impact assessment of the watershed management program implemented in the Mai zeg zeg watershed of Degua Tembein Woreda. The impact indicators of the integrated watershed management program are limited to the food security indicators based on the program intervention and components in the targeted area. It does not attempt to make a detailed impact analysis of each component but simply their impact on the food security level of the targeted households. It however focuses on the comparison of the program eligible participants and eligible but non participated similar groups in the neighborhood location of the project geographic territory. Geographically, the study concentrates on the one watershed of Degua Tembein Woreda of the Highlands of Tigray, in northern part of the country.

1.6. Significance of the Study

In the process of ensuring food security and rural livelihood enhancement knowing the exact contribution of a single watershed management food security program to overall food security of the targeted group is a basic corner stone in deciding whether to invest and expand similar massive food security programs elsewhere in the food insecured areas. To realize this fact, many efforts through the application of different proxy strategies to measure an impact, were made and are still going on but using different proxy measure of an impact cannot take us to a better conclusion of a single program. Nevertheless, the application of appropriate impact evaluation technique regularly with continues recordkeeping of program data can give a pleasant condition for batter decision making. The output of formal impact evaluation practice leads to design better watershed food security program, moreover it can be good ground of learning and dissemination of best practices for further sustainability.

The livelihood interventions are best sustainable when they are accompanied with meaningful and measurable impacts for the intended group. In order to have secured

and sustainable rural livelihood it is crucial to give due emphasis to the role of impact evaluations in tracking better interventions which can contribute to the improvement of the rural livelihood. Due to this fact that, assessing and knowing the overall impact of a watershed based food security program in any given area and community is helpful in deciding and making more sustainable development intervention.

Therefore this study will help in filling the existing knowledge gap of the concerned topic and will contribute to the community of Mai Zeg- Zeg watershed, local and regional development actors to think of the importance of the impact evaluation practice of all similar food security programs and make appropriate watershed intervention which can enhance the food security and better livelihoods of the rural communities.

1.7. Limitation of the study

The study is limited to the impact assessment of the integrated watershed management program on food security in Mai zeg zeg watershed of Degua Temebin woreda .The impact assessment is based only on the income level, environment and water coverage and related impacts . It is based on the empirical evidences from the collected survey data of three Peasant Associations (*Tabia*s). It may not provide extensive analysis on the overall impact of the watershed program on food security. While estimating the environmental impact the results are based on the responses of the surveyed households, observations and photos but the researcher did not made detailed technical measures on the environment. Hence, the study is limited in terms of providing comprehensive idea about overall impact, problems, potential solutions and opportunities to make inferences for possible policies and practices on issues related to the impact of the watershed management program on food security.

CHAPTER- II: LITERATURE REVIEW

2.1 Theoretical Background;

2.1 1. Definitions and basic Concepts;

Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern**.**

Food insecurity: exists when people do not have adequate physical, social or economic access to food as defined above *(FAO, 2002***).**

***USAID defines food security* as follows**: When all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life. Achieving food security requires that the aggregate availability of physical supplies of food is sufficient, that households have adequate access to those food supplies through their own production, through the market or through other sources, and that the utilization of those food supplies is appropriate to meet the specific dietary needs of individuals *(Riely et al.*, 1999).

Chronic food insecurity: When individuals or groups of people suffer from food insecurity all of the time, then they can be said to suffer from chronic food insecurity.

Transitory food insecurity: occurs when households face a temporary decline in access to food .Transitory food insecurity can be further divided into **temporary food** insecurity and **cyclical or seasonal** food insecurity. Temporary food insecurity occurs when sudden and unpredictable shocks, such as drought or pests attach, affects a household's entitlements. Seasonal food insecurity occurs when there is regular pattern of inadequate access to food (*Thomson &Manfred, 1997*).

Watershed: a watershed defined as an area in which all water drains to common point. From a hydrological perspective a watershed is a useful unit of operation and analysis because it facilitates a systems approach to land and water use in interconnected upstream and downstream areas. In dry land areas such as the Ethiopia semi-arid areas, watershed projects aim to maximize the quantity of water available for crops, livestock and human consumption through on-site soil and moisture conservation, infiltration into aquifers, and safe runoff into surface ponds. In catchments areas of hydroelectric dams, watershed projects typically focus on minimizing soil erosion that deposits sediment into reservoirs and to the maintenance of base flow (*Kerr and Chung, 2001).*

Watershed management: The analysis, protection, development, operation or maintenance of the land, vegetation and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality and timing of the water which is produced and also referred to as water management and Basin management **(**see *dictionary.babylon.com***).**

Evaluation: An evaluation is an assessment, as systematic and objective as possible, of ongoing or completed program or project activities, their design, implementation and results. The aim is to determine the relevance and fulfillment of objectives, developmental efficiency, effectiveness, impact and sustainability. Evaluation of Development program describes what has happened and why, using reliable and transparent methods of observation and analysis. (*DFID, 2005*)

Evaluation normally involves some standards, criteria, measures of success, or objectives that describe the value of the program/project. Evaluation can identify criteria for success, lessons to learn, things to achieve, ways to improve the work, and the means to move forward. *(Zarinpoush, 2006**)***

Ex-post evaluation: is conducted after the project or program is completed and is used to assess sustainability of project/program effects and impacts. It further identifies factors of success to inform other projects /programs.

Impact: The term impact refers to the set of program results that occur at the beneficiary-level and that can be directly attributed to program activities, rather than external factors.

Impacts may be defined as intermediate improvements in the capability of program beneficiaries to influence their own lives, such as through improved access to resources, or improved knowledge attained through training programs. More typically, impacts may also refer to final improvements in the economic and personal well-being of individuals who receive goods and services through the program. Impacts are often confused with program outputs, which refer to the quality and quantity of goods and services delivered through program activities (Riely *et al.*, 1999)**.**

Impact Evaluation: is the systematic identification of the effects – positive or negative, intended or not – on individual households, institutions, and the environment caused by a given development activity such as a program or project**(***World Bank, 2004*).

Impact evaluation **is a** gauge that measures the extent to which a program causes changes in food security conditions, such as improvements in food self sufficiency and nutritional status at the beneficiary-level or more. Results from impact evaluations are critical to guide the management of program activities, to inform resource allocation decisions across program components and to support the design or re-design of future interventions to maximize their potential impacts (Riely *et al.*, 1999).

Environmental impact is an impact –positive or negative –that a proposed project/program may have on the environment, together consisting of the natural, social and economic (*See Wikipedia, the free encyclopedia*).

2.2 Concept of Food Security

2.2.1 Food security at the different levels

Food security is a multi-faceted concept, variously defined and interpreted. At one end of the spectrum food security implies the availability of adequate supplies at a global and national level; at the other end, the concern is with adequate nutrition and well being *(Morrison & Pearce, 2000*).

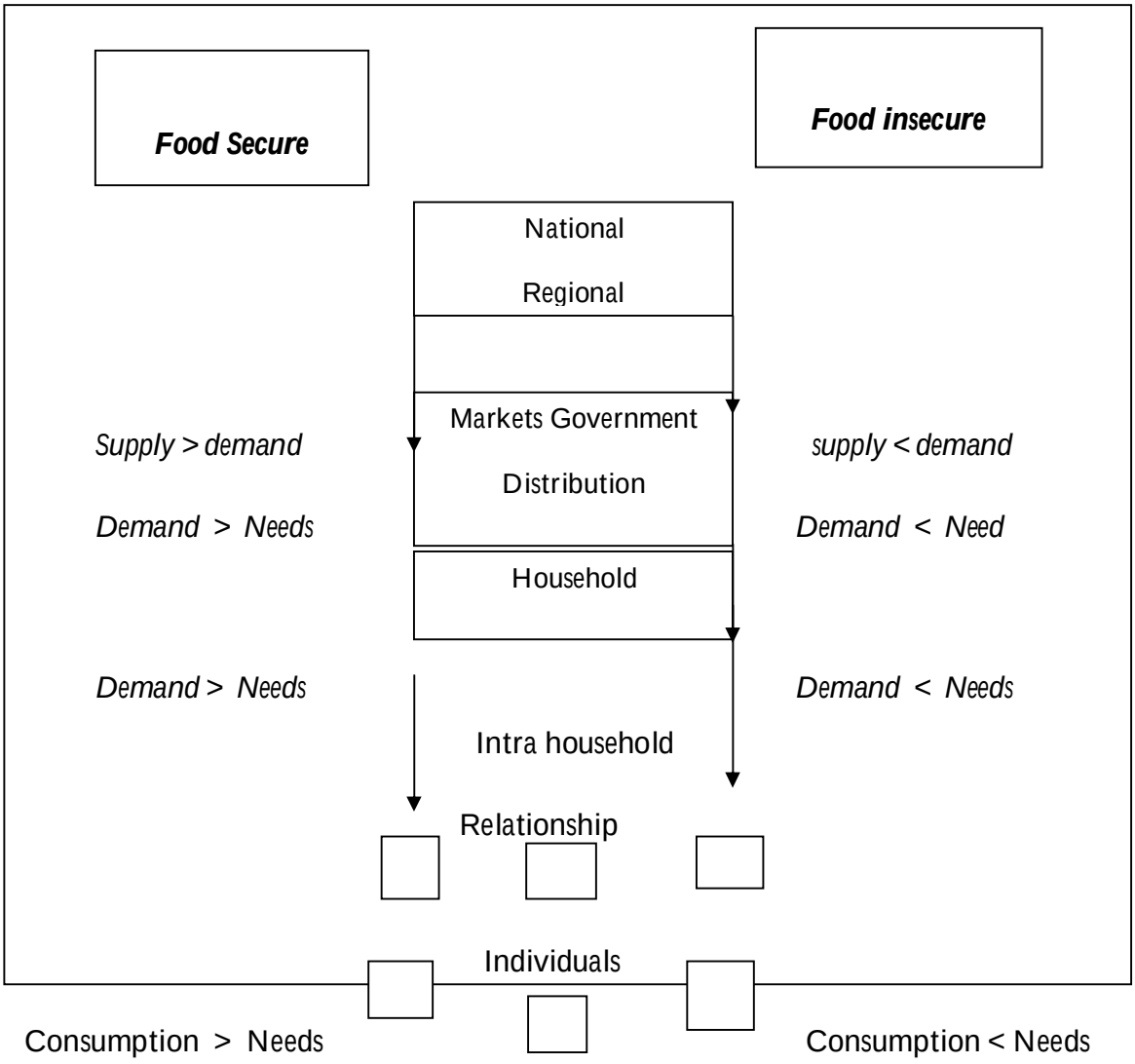

Figure1. Different levels of food security.

Source: Implication of economic policy for food security: Thomson & Manfred, 1997.

Figure1.Shows the most important interactions between all three levels of analysis. At first level Food security at national level is perhaps best described as satisfactory balance between food demand and food supply at reasonable prices. In the second level, households are identified as food secure if their entitlements, or demand for food is greater than their needs defined as the aggregation of individual requirement. Lastly at individual level, an individual is food secure if his or her food consumption is always greater than need, as defined by physiological requirement.

2.2.1.1 The Extent of Global Food Insecurity

Recent initiatives aimed at improving the food security situation of the poor - most notably the World Food Summit (WFS) - have been stimulated by the fact that although food availability for direct human consumption grew by 19 percent between 1960 and 1994-96, to 2 720 kcal/day (against an estimated minimum daily energy requirement of 2 200 kcal/day), availability is still very uneven. In sub-Saharan Africa (SSA) calorific intake is still only 2 150 kcal/day compared to 2 050kcal/day thirty years earlier. In contrast, the average calorie consumption in South Asia rose from 2 000 kcal/day to 2 350 kcal/day in the same period.

However, during the 1990s per capita growth of world agricultural production slowed. World cereal output, for example, fell from a peak of 342 kg per person in the mid 1980s to 311 kg per person in 1993-95, although it has since risen to 323 kg per person in 1996-98 *(FOA, 1991).*

The results of such statistics are evident in the fact that in 1995-97, 820 million were estimated by the FAO to be undernourished, with 790 million living in developing countries. Although the number of undernourished people in developing countries actually fell by 40 million between 1980/82 and 1995/97, this improvement was also uneven, being attributable to a reduction of 100 million in 37 countries, whilst in the

remaining countries the numbers increased by 60 million. In addition, the fall in absolute numbers is too low to achieve the world food security (WFS) goal of reducing the numbers of undernourished by half by 2015, since this would require an additional reduction of 20 million undernourished individuals each year until that date(FAO,1999).

2.2.1.2 Food security indicators

The United States Department of Agriculture (USDA, 1999) evaluates two aspects of food security, availability and distribution, both of which capture the extent of the shortfall, and analyze predicted trends through to 2009. The most recent study covers 67 countries that have been, or are, potential food aid recipients. Two key indicators are used: first, the ***Status Quo* gap**, which measures the difference between projected food supplies (calculated as domestic production plus commercial imports minus non-food uses) and a base period (1995-97) per capita consumption; and second, the Nutrition gap, which is the difference between projected food supplies and the amount of food needed to support minimum per capita nutritional standards. The *Status Quo* indicator provides a safety net criterion, whilst the Nutrition gap indicator gives a comparison of relative well-being. In some regions, the size of food gaps is quite small relative to commercial imports, meaning that if imports grew at a slightly higher rate the projected gaps could close (for example in North Africa and in Latin America and the Caribbean). In Asia however, the ratio of the nutrition gap to commercial imports is about 20 percent and in SSA it is projected to be 229 percent. It is highly unlikely that the gap can be filled. Food imports would need to grow by 10 percent per year in SSA and 4.7 percent in Asia to fill this gap by 2009.

2.2.1.3 Household food security

The ability to ensure adequate food security hinges on the ability to identify vulnerable households. Vulnerability refers to the full range of factors that place

people at risk of becoming food insecure. The degree of vulnerability of an individual, household or group of persons is determined by their exposure to the risk factors and their ability to cope with or withstand stressful situations. Generally, vulnerable households will constitute three groups:

- Those which would be vulnerable under any circumstances: for example, where the adults are unable to provide an adequate livelihood for the household for reasons of disability, illness, age or some other characteristic;
- Those whose resource endowment is inadequate to provide sufficient income from any available source;
- Those whose characteristics and resources render them potentially vulnerable in the context of social and economic shocks: e.g. those who find it hard to adapt to sudden changes in economic activity brought about by economic policy. A significant increase in the consumer price of staple foods might be an example.

Although no definition of 'vulnerable' is complete, a useful starting point is estimates of income. It can be assumed that the first two categories will be relatively poor both in terms of income and assets, and it is also likely that the third category will have a fragile resource base and other characteristics which make its income sources uncertain. An appropriate proxy, therefore, in identifying vulnerable households, is how poor is a particular household measured against some established criterion or 'poverty-line'.

Having defined who the poor are, the second step is to identify their household characteristics:

- Location: rural/urban; small village/large village; remote province/near to capital city etc.;
- Composition: size, age and dependency ratios; male/female head;

- Sources of income: production, employment, trade, remittances and other transfers. (see http://www.fao.org/docrep)

Events such as civil unrest or climatic disasters can seriously deplete households' resource potential, and increase the likelihood of structural food insecurity. If what might have appeared as a transitory problem is not to become chronic, the replenishment of productive capability should be a necessary part of programs aimed at reversing this process. Physical resources by themselves, however, may be inadequate, and the upgrading or changing of the range of skills possessed by household members may be a necessary component of any program. Consequently, training in new agricultural techniques, or in the necessary skills required by local industries or trades, can form an integral component of food security interventions.

For many poor households, particularly those whose resource base been eroded by drought, additional resources are the primary requisite if their productive base is to be restored. Recognition of this is apparent in the increasing emphasis on development programmes by governments, agencies and donors alike. For other households, both rural and urban, access to productive resources may be less relevant. These will seek, according to their location and particular skills, to generate entitlement to food through trade or direct employment.

The promotion of income-generating activities of employment opportunities and self-employment (particularly those associated with the rural informal sector), forms a second essential approach to food security.

Moreover, in circumstances where both the outcome of productive activity is always uncertain and the purchasing power of cash-generating activities is subject to sudden and dramatic shifts, it is both probable and desirable that households will seek to diversify their occupations. This may be either through the principal income earner undertaking a variety of activities, or through different household members generating

income or produce from a variety of tasks. Here again, policies designed to promote food security might also simultaneously address resource and skill constraints.

It is important to recognize, however, that access to food through any of these entitlement endowments contributes only to the availability of food to the household. It does not ensure efficient utilization and says nothing regarding intra-family distribution, both of which can have a profound effect on nutritional status regardless of food availability *(Drèze & Sen, 1989*).

2.2.1.4 Food Security in Ethiopia

"*Perhaps the greatest challenge that the country faces is that of ensuring food security. This is so because of the low technological base of agriculture, limited rural infrastructure and off-farm employment compounded by neglect and inappropriate policies over many years. The food security strategy, whose implementation has begun, is meant to break the complex problems to close the food gap and ensure food security" [~ Mekonnen (2000:14)], in* (*Devereux S., 2000).*

Food insecurity incorporates low food intake, variable access to food, and vulnerability – a livelihood strategy that generates adequate food in good times but is not resilient against shocks. These outcomes correspond broadly to chronic, cyclical and transitory food insecurity, and all are endemic in Ethiopia. The main triggers of transitory food insecurity in Ethiopia are drought and war. Seasonality is a major cause of cyclical food insecurity. Structural factors contributing to chronic food insecurity include poverty (as both cause and consequence), the fragile natural resource base, weak institutions (notably markets and land tenure) and unhelpful or inconsistent government policies (Devereux, 2000**).**

Significant parts of Ethiopia are characterized by persistent food insecurity. While droughts and other disasters (such as floods) are significant triggers, more important are the factors which create and/or increase vulnerability to these shocks and which

have undermined livelihoods. These factors include land degradation, limited household assets, low levels of farm technology, lack of employment opportunities and population pressure. As a consequence, but also exacerbating the situation, levels of education are low and disease prevalence is high (MoARD, 2009).

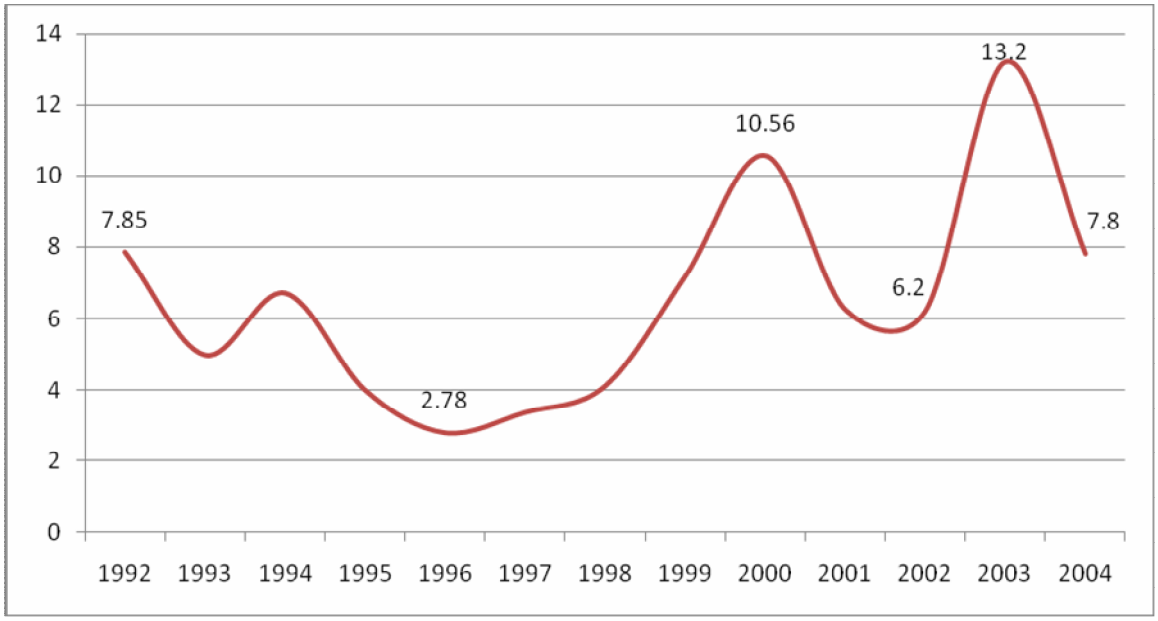

Figure2. Number of People in Need According to Emergency Appeals

Source: MoARD, 2009, Food Security Program.

Although the food insecurity is predominately chronic ,it is frequently aggravates and turns out to be more acute ,and on the average over five million people are enlisted for daily relief food per annum over last decade ,even when the weather and market condition appear to be normally good. This condition in Ethiopia leads to shift between chronic and acute food insecurity expressed by broad and deep crisis, which often is the characteristic of drought prone areas with low and variable rainfall, high population density and low natural resource endowments **(***MoFED, 2003).*

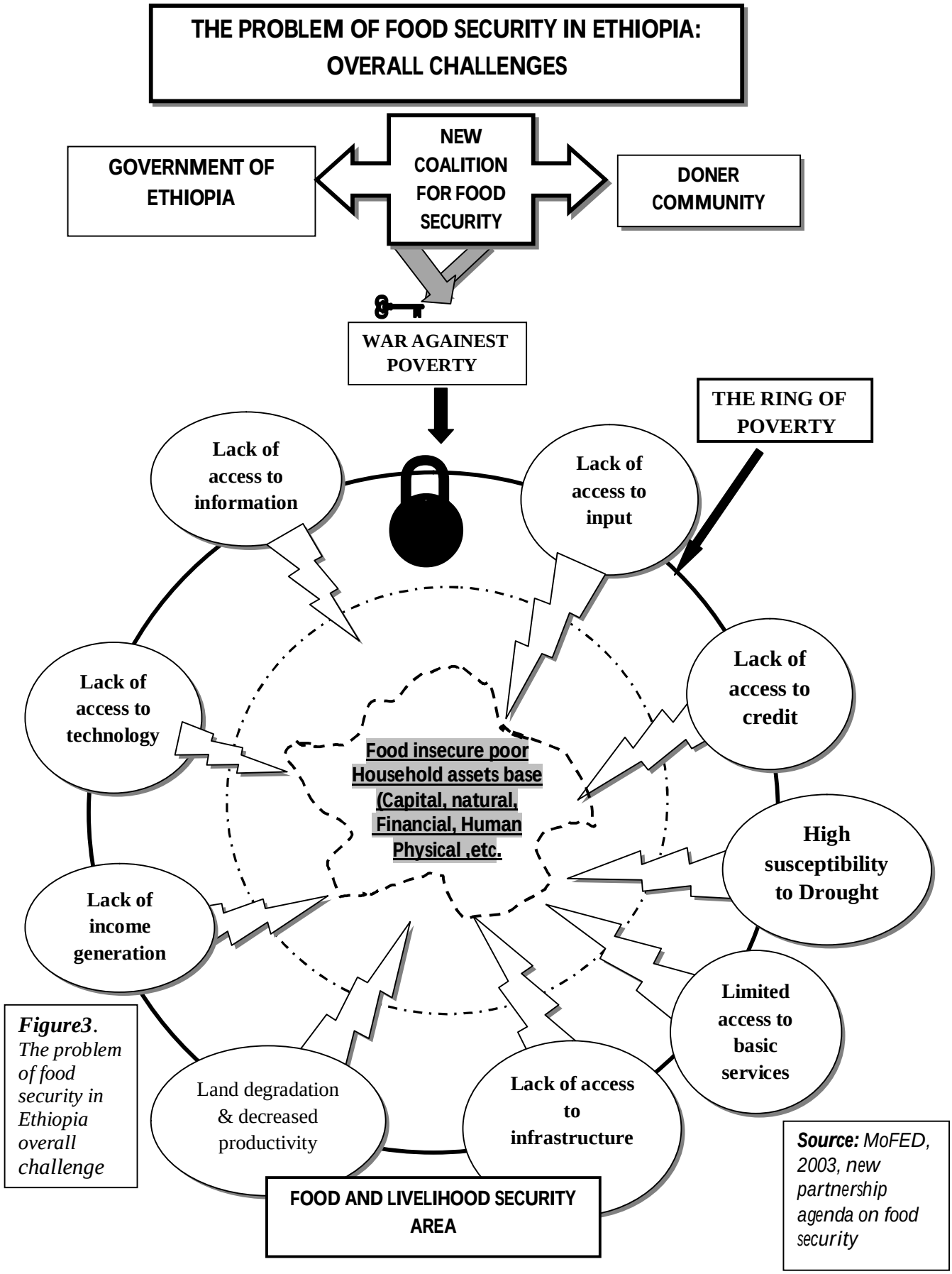

Figure3. *The problem of food security in Ethiopia overall challenge*

Source: *MoFED, 2003, new partnership agenda on food security*

The government's strategy of Agriculture Development Led Industrialization (ADLI), as formulated in 1994, views agriculture as the driving force of the economy, and argues for investment in agriculture as both a motor for economic growth and a means of ensuring household and national food security. ADLI aims to promote the adoption of improved technological inputs and practices, in order to raise agricultural productivity and generate savings for investment in other sectors. The major components of ADLI include: input provision to peasants, promotion of small-scale irrigation, improved livestock herds, environmental protection and natural resource management, grain marketing efficiency, promotion of farmers' organizations and women's participation in agriculture, expanding rural roads (*Holt and Dessalegn 1999:2).*

To tackle the problem of food insecurity in the country, in line with the Agriculture Development Led Industrialization (ADLI), the government of Ethiopian has designed the federal food security strategy which has three main pillars: (1) increase supply or availability of food ;(2)Improve access/entitlement to food;(3)Strengthen emergency response capabilities (FDRE,2002).

2.2.1.5 Food Security Analytical Framework

Figure4.below outlines the USAID food security framework, highlighting the three dimensions of availability, access, and utilization, and the nature of their relationship to one another, as well as a brief description of their determinants. As indicated in figure4, ***food availability*** is a function of the combination of domestic food stocks, commercial food imports, food aid, and domestic food production, as well as the underlying determinants of each of these factors. Use of the term *availability* is often confusing, since it can refer to food supplies available at both the household level and at a more aggregate (regional or national) level. However, the term is applied most commonly in reference to food supplies at the regional or national level.

Food access is influenced by the aggregate availability of food through the latter's impact on supplies in the market and, therefore, on market prices. Again, figure 1 indicates that access is further determined by the ability of households to obtain food from their own production and stocks, from the market, and from other sources. These factors are, in turn, determined by the resource endowment of the household which defines the set of productive activities they can pursue in meeting their income and food security objectives.

Food access also is a function of the physical environment, social environment and policy environment which determine *how effectively* households are able to utilize their resources to meet their food security objectives. Drastic changes in these conditions, such as during periods of drought or social conflict, may seriously disrupt production strategies and threaten the food access of affected households. To the extent that these shocks often lead to the loss of productive assets such as livestock, they also have severe implications for the future productive potential of households and, therefore, their long-term food security. To cope with those shocks and minimize potential declines in food access, households typically adjust their consumption patterns and reallocate their resources to activities which are more insulated from the influence of those risks. In drought periods, for example, households may shift their labor resources from crop production to non-farm wage employment or sell-off small assets to ensure continued income. They may also adjust their consumption patterns, reducing their dietary intake to conserve food and relying more on loans or transfers and less on current crop production and market purchases to meet their immediate food needs.

Food utilization**,** which is typically reflected in the nutritional status of an individual, is determined by the quantity and quality of dietary intake, general child care and feeding practices, along with health status and its determinants. Poor infant care and feeding practices, inadequate access to, or the poor quality of, health services are also major determinants of poor health and nutrition. While important for its own sake as

it directly influences human well-being, improved food utilization also has feedback effects, through its impact on the health and nutrition of a household members, and therefore, on labor productivity and household income earning potential **(**Riely*etal.*,1999:12_14).

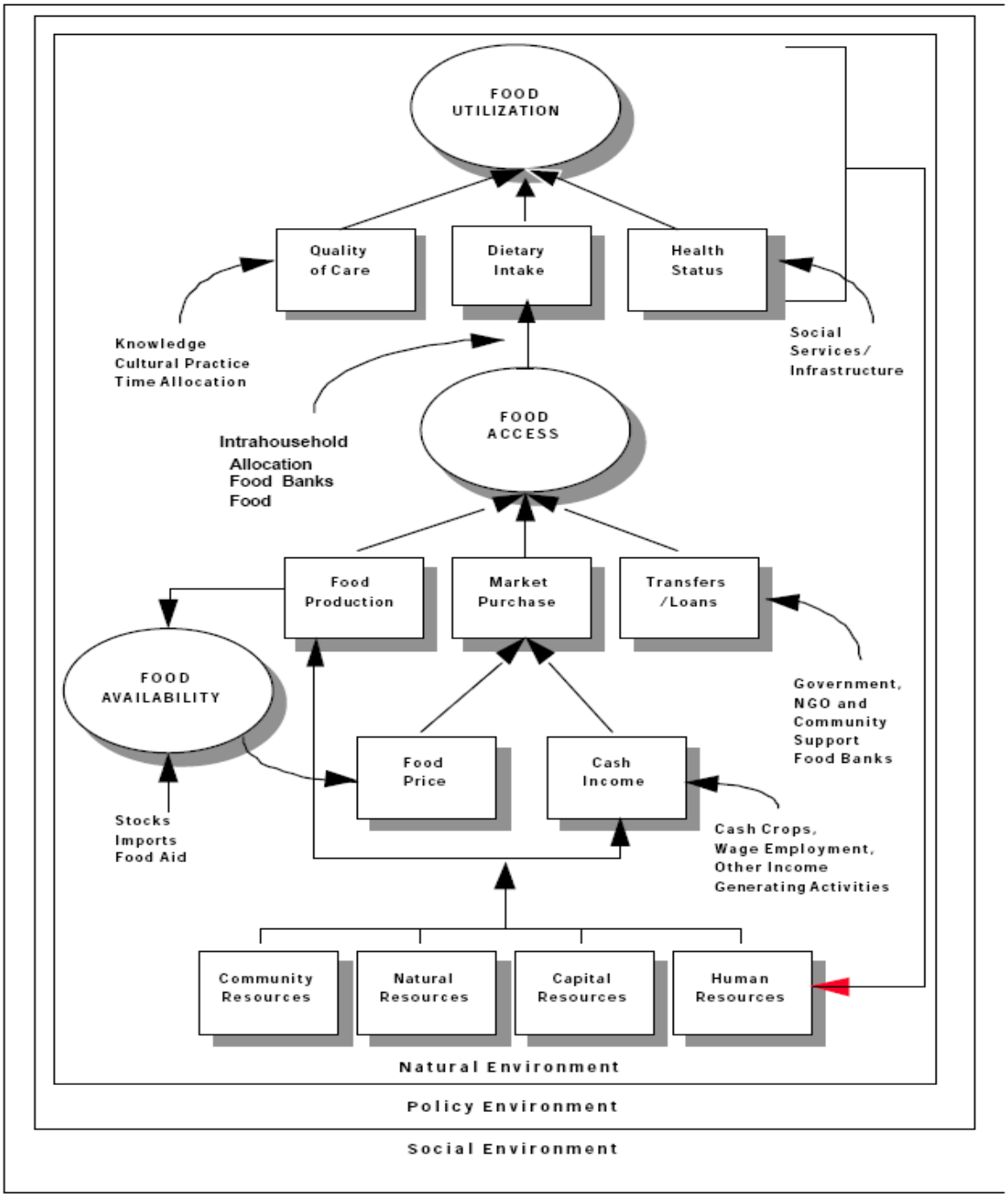

Figure4. Food security conceptual framework

Source: Riely et al., 1999, Food Security Indicators and Framework for Use in the Monitoring and Evaluation of Food Aid Program

2.3 Concept of Watershed Management

Watershed management refers to the management of the geographical area that collects all the water that falls on it into a single stream or river. A watershed management is thus a management of naturally demarcated area of land that is suitable for many development activities. 'Watershed development' is a critical intervention in low-rainfall areas to make the land more productive(***see*** http://www.indiawaterportal.org).

The primary concern of watershed management is to organize and guide the use of land and other watershed resources to ensure the sustainability of water, soil and the flux of watershed goods and services. The task is never easy even when there is only one resource to consider, but it is definitely simpler than having to deal with a watershed where resources and users are numerous and diverse (Cruz, *2000*).

Watershed management organizes and guides the use of land, water, and other natural resources to provide the goods and services demanded by society, while ensuring the sustainability of the soil and water resources. A watershed management approach to land stewardship incorporates soil and water conservation and land-use planning into a holistic and logical framework. This is necessary because people are affected by the interaction between water and other resources, and because people influence the nature and severity of these interactions when they use resources. Adoption of a watershed management approach to land stewardship is accomplished through the combined efforts of technically trained planners and managers, decision makers, locally led advocacy groups, and other concerned stakeholders. (Ffolliott *et al.,2003)*.

Watershed management projects aim to arrive at 'win-win' solutions – in which for example water retention through construction of bunds leads both to increased rain fed crop yields, and greater groundwater recharge. The key underlying assumption is that good land management will lead to increased availability of water resources for productive and domestic use (*Moriarty et al., 2001*).

For the better impact the watershed management programs has to follow a multi-sectoral approach; a combination of bottom-up and top-down planning, monitoring and evaluation; clear procedures for environmental impact assessment of interventions including water and soil conservation , dams and reservoirs; networking among key stakeholders; consideration of both socio-economic and cultural aspects and natural processes; gender balance in decision making; embracing new approaches for sharing knowledge and learning; sustainable finance; competition mechanisms; capacity building at all levels; reforming governance; efficiency of watershed resource use; coping with hydrologic extremes and natural hazards; and the integrated management of water, vegetation, soils and sediments (*FAO, 2003*).

Similarly the Integrated Watershed Management Program proposes a framework for fostering interdisciplinary on-ground implementation activities. Interdisciplinary takes on a meaning of multiple dimensions and scales. In one instance vertical dimensions: encompassing both surface water and ground water quality at the watershed scale. In the other instance, the lateral dimension considering the varied land uses and land covers associated with agriculture, silviculture, mining, and hydrologic/habitat modification activities, as well as those associated with urbanization (e.g., land development, transportation, recreation, etc.). These land uses and activities give rise to varying degrees of nonpoint source pollution or polluted runoff, which is the major contributor to impaired waters ***(****Stevenson, 2003****).***

2.3.1 Types of Watershed

Watersheds could be classified into a number of groups depending upon the mode of classification. The common modes of categorization are the size, drainage, shape and land use pattern. The categorization could also based on the size of the stream or river, the point of interception of the stream or the river and

1) Macro watershed (> 50,000 Hect)

2) Sub-watershed (10,000 to 50,000 Hect)

3) Milli-watershed (1000 to10000 Hect)

4) Micro watershed (100 to 1000 Hect)

5) Mini watershed (1-100 Hect)

A watershed could be described as fan shaped (near circular) or fen shaped (elongated). Hydrologically the shape of the watershed is important because it controls the time taken for the runoff to concentrate at the outlet. Watersheds may also be categorized as hill or flat watersheds, humid or arid watersheds, red soil watershed or black soil watershed based on criteria like soil, slope, climate etc. Depending on the land use pattern watershed could again be classified as highland watersheds, tribal settlements and watersheds in areas of settled cultivation (Callig, 2004***).***

2.4 Concept of Impact Evaluation

Impact evaluation assesses the change that can be attributed to a particular intervention, such as a project, program or policy, both the intended ones, as well as ideally the unintended ones(*World bank ,2008*). In contrast to outcome monitoring, which examines whether targets have been achieved, impact evaluation is structured to answer the question: how would participants' well-being have changed if the intervention had not been undertaken? This involves counterfactual analysis, that is, "a comparison between what actually happened and what would have happened in the absence of the intervention" (*White, 2006*).

Impact Evaluation helps us to answer key questions for evidence-based policy making: what works, what doesn't, where, why and for how much? It has received increasing attention in policy making in recent years in both Western and developing country contexts. It is an important component of the armory of evaluation tools and approaches and integral to global efforts to improve the effectiveness of aid delivery and public spending more generally in achieving outcomes. Originally more oriented towards evaluation of social sector programs in developing countries, notably

conditional cash transfers, impact evaluation is now being increasingly applied in other areas such as the agriculture, energy and transport (*Briceno and Gaarder, 2009).*

In many cases the impact evaluation assessment will be expected to assess impact on very broad goals, such as poverty alleviation. Unless the intervention can be expected to have a direct impact on such goals, it may be appropriate to identify relevant intermediary factors (e.g. food security), and limit the assessment to impacts on them. The linkages between intermediary factors and broader goals can often be assessed reliably only through a complex policy-level impact assessment. In general, the targets and indicators used in the assessment will be those for which the intervention can be expected to have a direct impact.

Whatever the precise scope of the assessment in relation to particular social, economic or environmental objectives, consideration should be given to the following potential issues:

- **Time-dependency** - might impacts that are small (or large) at the time of the assessment increase (or decrease) with time?
- **Changing or abnormal conditions** - how secure is an observed impact, in relation to economic or environmental shocks and other conditions which may vary from those pertaining at the time of the assessment?
- **Cumulative effects** - would a small effect become significant if the intervention or its effects were replicated?
- **Remote effects** - might unplanned impacts be occurring beyond the boundaries of the study area or community?
- **Second order effects and interactions** - might unplanned impacts be occurring that are not obviously associated with the intervention?

The last of these issues can entail a complex investigation of the interlinkages between social, economic and environmental impacts. A fully integrated impact assessment of this nature would be required if potentially important interactive effects are identified within the scope of the assessment or subsequently (Figure 5) (Kirkpatrick, *et al., 2006*).

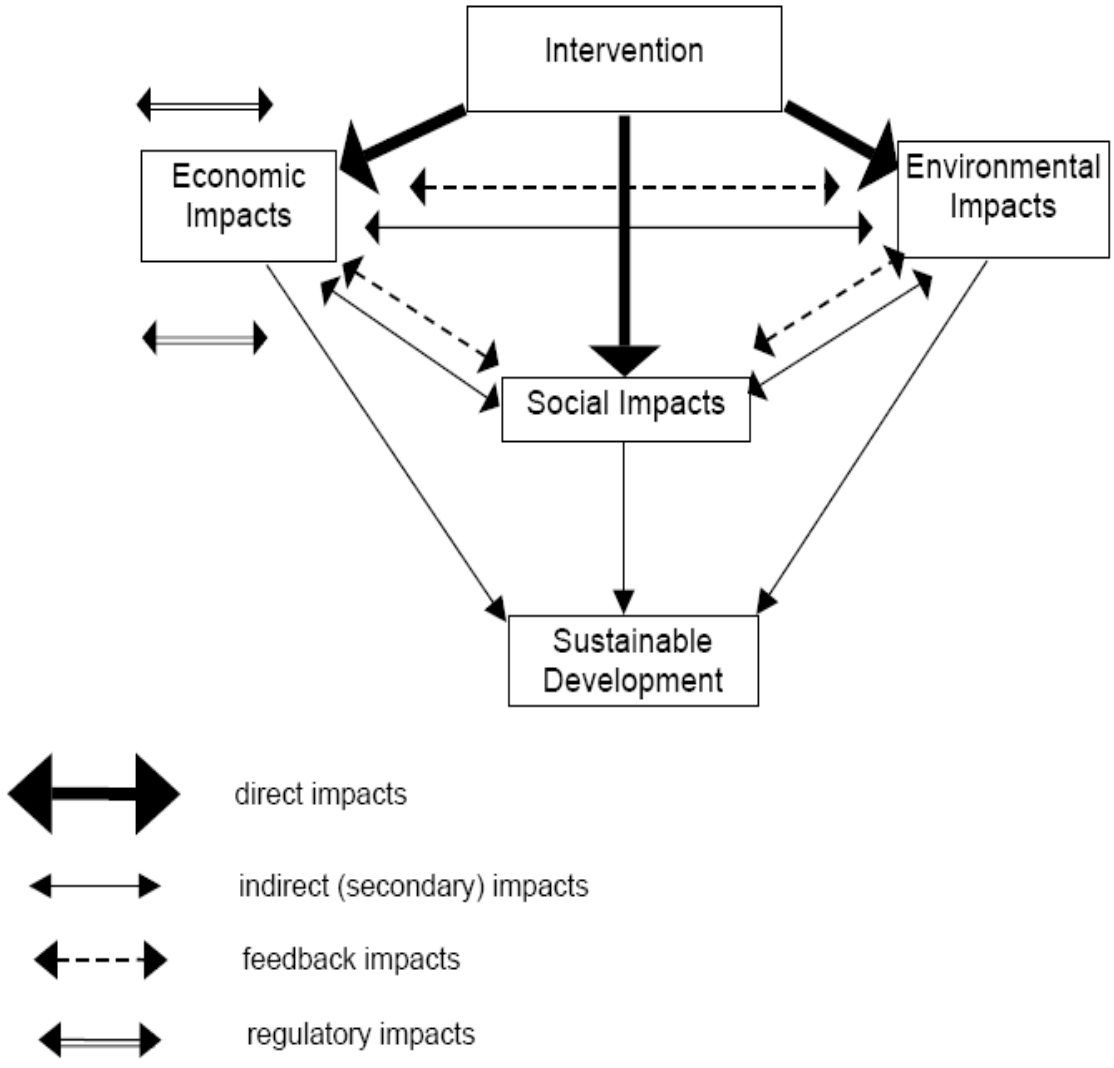

Figure5. Types of Impact on Sustainable Development

Source: Kirkpatrick, et al., 2006, Basic impact assessment at project level.

2.5 Empirical studies:

2.5.1 Impact assessment of watershed management programs on food security

An almost infinite array of variables can be identified to assess impacts on different watershed programs on different units. To be of use these must be able to be defined with precision and must be measurable. Conventionally, economic indicators have dominated, with assessors particularly keen to measure changes in income despite the enormous problems this presents. Other popular variables have been levels and patterns of expenditure, consumption and assets. A strong case can be made that assets are a particularly useful indicator of impact because their level does not fluctuate as greatly as other economic indicators and is not simply based on an annual estimate.

The social indicators that became popular in the early 1980s (e.g. educational status, access to health services, nutritional levels, anthropometric measures and contraceptive use) have recently been extended into the socio-political arena in an attempt to assess whether project interventions can promote empowerment (Kirkpatrick, *et al., 2006)*.

Impact assessment conducted in Indian watershed development projects have used economic and environmental indicators like impact on land use pattern, cropping pattern, crop yield, check in soil erosion (Deshpande and Rajasekaran 1997). Some other papers have discussed issues like participatory process and scale of observation (Bollom, 1998, Shah 2004). Chopra et al (1990) used social cost-benefit analysis (CBA) which included pricing at both market and shadow prices and then adjusted with income distribution effects. Chopra (1998) used multi-criteria analysis which included environmental, economic, social and institutional component. These studies provide good description of the impact but they do not explain fully why the differential impact occurs. The most common reason cited for poor impact is lack of people's in project related decisions. Poor planning and monitoring are also considered as major

factors behind sub-optimal results (*AravalI, 2001, Rama Chandrudu 2006*). Directly or indirectly, the responsibility is passed on to the implementing agency.

The agency-centered explanation of differential impact does not take into consideration the influence of various stakeholders (actors) involved at various stages of the project cycle (*Mishra**, 2008***).

A study conducted by Andersson *et al (2009**)*** on the impacts of the Ethiopian Productive Safety Net Program (PSNP) on rural households' holdings of livestock and forest assets including trees .They found no indication that participation in PSNP induces households to disinvest in livestock or trees. In fact, households that participated in the program increased the number of trees planted, but there was no increase in their livestock holdings. They found no evidence that the PSNP protects livestock in times of shock. Shocks appear to lead households to disinvest in livestock, but not in trees. Their results suggest that there is increased forestry activity as a result of PSNP, and that improved credit access encourages households to increase their livestock holdings.

The study conducted by Grewel *et al (1999) on* poverty Alleviation and Resource conservation through integrated watershed management in a fragile foot –hill ecosystem shows that the construction of a large number of village ponds and water harvesting structures has improved the availability of water .Substantial improvement in productivity and employment generations motivated the stakeholders to take the responsibility for protection of adjoining hilly forest catchment by forming village cooperatives . After a long time nature has been allowed to spread its green protective cover on eroded barren hill slopes. All these have resulted in overall improvement in the standard of living as indicated by the increased number of tractors, television sets and availability of surplus milk for sale. The significant contribution includes forceful demand of the communities for continuing the project even at higher rate of cost

sharing because the project has brought back the lost smile and hope to the desperate section of the society .

On the other hand similar study conducted by Yoganand and Gebremedhin (2006) on Participatory Watershed Management for Sustainable Rural Livelihoods in India has suggests that participatory watershed management programs made significant impact in terms of productivity gains in rain-fed areas which contributes to the raised farm income and better livelihoods of the poor in fragile and high risk environments. The watershed programs have also helped in improving soil moisture content.

2.5.2 Conceptual frame work for Impact Evaluation of watershed development projects

Integrated impact assessment has been a growing area of study and practice. Birley (2003) tried to combine health impact assessment with environment impact assessment (EIA) and he observed that for integrated assessment, piecemeal approach had been followed that led to wide degree of overlap. Ziller and Phibbs (2003) integrated social impact into cost-benefit analysis. They followed participatory method (through stakeholder consultation) and prepared a matrix integrating financial as well as nonfinancial costs and benefits incurred by or accrued to individuals and groups. The matrix brought in social issues in economic analysis, and the diversity of stakeholders made it a more comprehensive exercise. Bond *et al* (2001) conducted cost benefit analysis (CBA) and environmental impact analysis (EIA) separately including some elements of social impact assessment (SIA) for studying three hydropower and irrigation projects. They classified integration into 'weak' and 'strong' ones. Strong integration involved a single assessment that presented unified results to the decision maker, while weak integration referred to the opposite. They defined integration having three characteristics – use of consistent aspects, cross-disciplinary issues, and procedural arrangements.

Given these complexities, a new framework was developed for understanding the impact of the watershed development projects as depicted in Figure6.

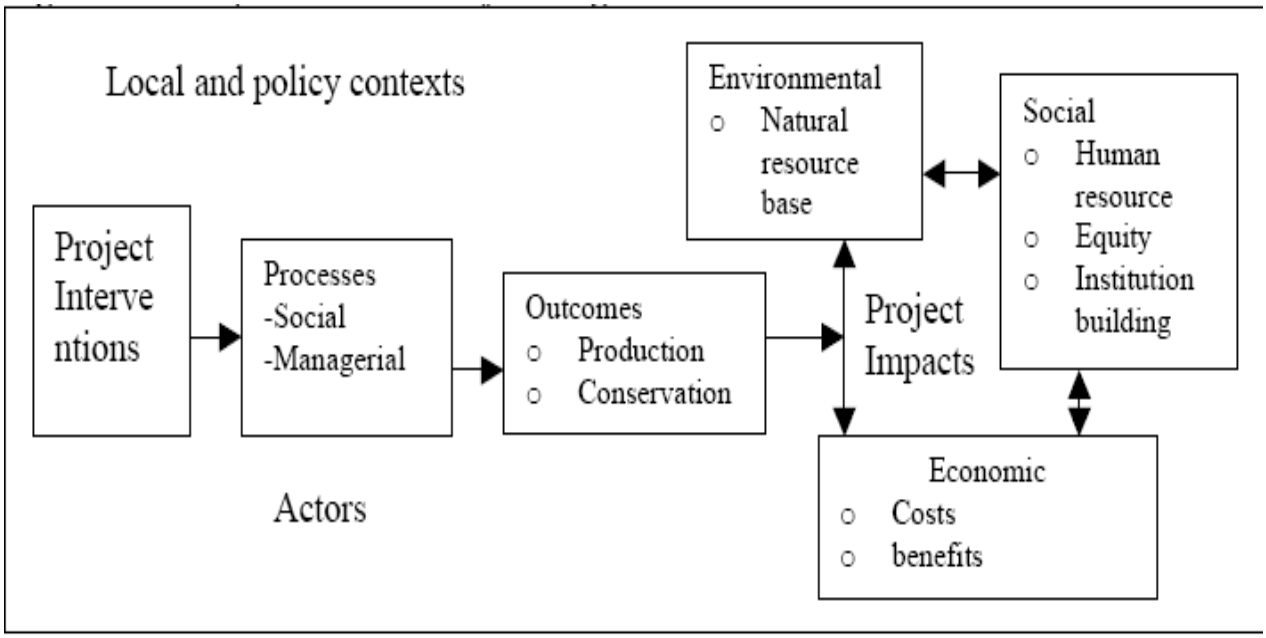

Figure6. Conceptual frame work for integrated impact assessment

Source: (Mishra, 2008) Integrated Impact Assessment for Explaining Differential Impact of Watershed Development Projects.

CHAPTER -III: MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Location of the study area

The study area is located in Dogu'a Tembien Woreda in Tigray region of the northern Ethiopian Highlands. Dogua Tembein woreda is found in south eastern zone of the region with total population of 113,526, out of which 56,921 are Male and 56,605 Female (*CSA, 2007*). The woreda has arable land of 27,083 ha, irrigable land of 80ha, natural forest of 21071.62 ha, grazing land of 44,479.67ha and cultivable land of 8928.1ha which is characterized with low status of livelihood (DTWoARD, 2009). The study was carried out in three Tabias, namely, Ayinmibrikekin Michael Abiy and Adiazemera which are located in central part of the woreda and are found, about 50 km to the west of Mekelle, capital city of Tigray region. The study area (Fig.7) is located in the Dogu'a Tembien (Tembien highlands) district in central Tigray, near the district capital Hagere Selam. This area is believed to be a representative for the northern Ethiopian highlands, because of its elevation and morphology.

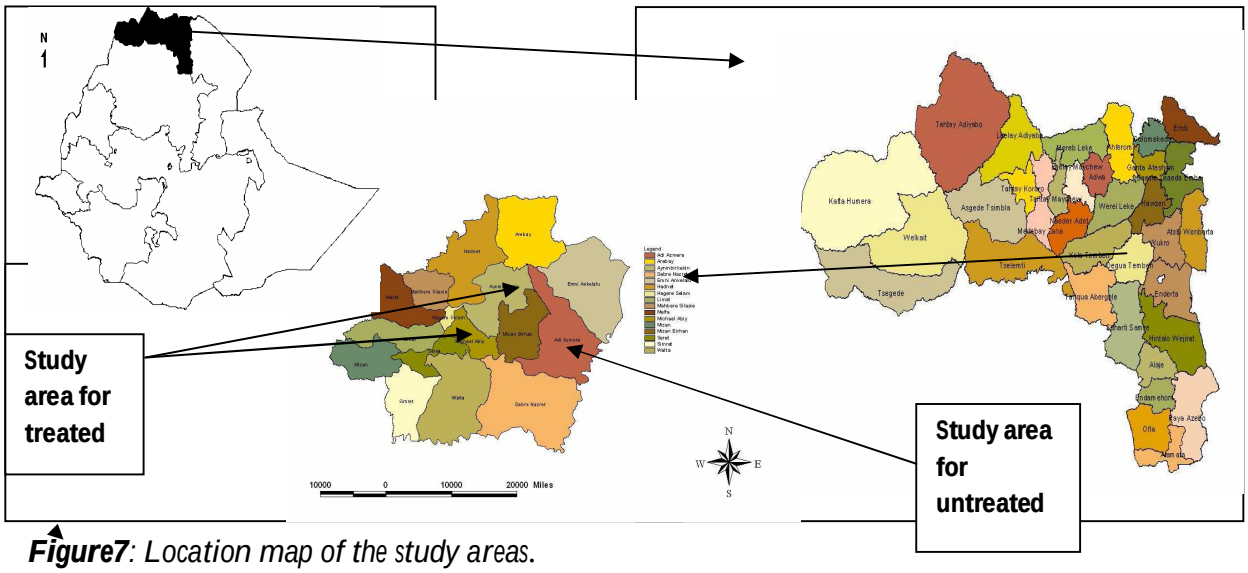

***Figure7**: Location map of the study areas.*

Source: BoFED, 2003.

3.1.2 The Maizeg zeg watershed

The Mai Zeg- Zeg watershed in which the study was conducted is found in central part of the Dogua Tembein woreda with area coverage of 122.2km2 and a total population of 23000. The watershed is known to have 65%of high land and 35%of middle altitude (***DTWoARD, 2009).***

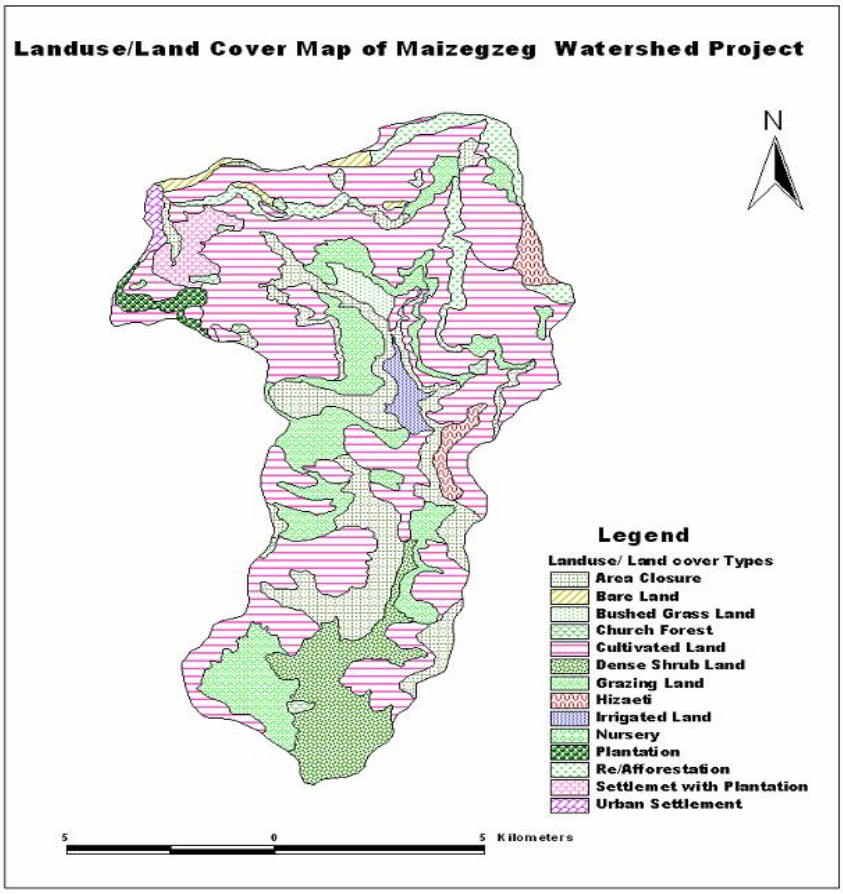

Figure8. GIS based land use / land cover map of the Mai zeg zeg watershed.

Source: Integrated watershed management project (2007)

The watershed consists of seven Tabias namely Aynmibrkekin, Michael Abiy, Mizanebrhan, Amanit, Endasilassie, Hagereselam, and Selam where the two Tabias were purposively selected to represent the treated group. These Tabias were selected

because they were a model implementation sites for the integrated Maizeg watershed project. On the other side if we see the location of Adiazemara Tabia which is taken as untreated (control) site, is located in central part of the woreda but outside the watershed where project intervention were not undertaken

3.1.3. Background of Mai zeg zeg Program

Based on the targeted community and Woreda request ADCS/Mekelle with the financial support of TROCAIRE and CAFOD has initiated an integrated watershed management program in the Mai zeg zeg watershed of Degua tembein woreda in 2004 and program has stayed for duration of five years since 2008. The overall objective of the program was to improve the livelihood of the communities in the villages of Anymnbrikekin and Micheal Aby Tabias and to demonstrate and promote global watershed management towards rural communities in the Highlands of Northern Ethiopia. The program components include: soil and water conservation, afforestation mainly through agro forestry, irrigation and potable water development, improve agricultural production and marketing and capacity building of farmers and involved staff on integrated watershed management.

Main stake holders of program were the regional government of Tigray, a local NGO, ADCS, which implemented the program, Mekelle University (Ethiopia) and Belgian institutions: carry out research on water conservation and watershed management in the target area, since 1994, local authorities and farmers, who liked this knowledge to be used for watershed management, the farmers of the district: very active participants in conservation activities, from planning to evaluation stages.

The program had direct beneficiaries of 3554 (both male and female) household heads.

The total project budget was 1 367 507 ETB, including a community contribution in kind of 68 375 ETB (*see MZZIWMP*, *2004*).

3.1.4 Climate

According to Degua Tembein Woreda Office of agriculture and rural development, agro-ecologically, Degua Temben wereda is categorized as High latitude for 44% of its area. Rainfall, the dominant factor to the life of each farmer, is characterized by late onset and early cessation in most of the villages in the district. Available rainfall records indicate that annual rainfall is minimal and varies from place to place due to altitudinal variation in the targeted villages. The rainfall pattern is bimodal where the main rainy season, *Kiremt,* is between June and August and the small rainy season, *Belg,* is between February and March. Usually, farmers do not rely on the latter season since the rain is not sufficient to support crop growth. As witnessed by the farmers, the amount of rainfall is not only small but is also decreasing year after year. The efforts, technology and knowledge made to make use of this small rainfall are also limited.

3.1.5 Farming system

3.1.5.1 Crop Production

The soils of the study area are prone to dry quickly with poor nature of moisture holding capacity. This low soil fertility of the targeted areas is further worsened by poor cultivation practices. Out of the total area an estimated 30-40% of the land is cultivated for seasonal crops (DTWAO, 2009). It is estimated that an average of only 1% of the land of the studied (treated) *PA*s is irrigated through the Mai Zeg Zeg Project intervention and traditional means. The average land holding size per household for the three villages is small which is estimated to range between 0.5- 0.75ha. At times of good rain, the average crop yield per ha in the villages is less than 5 quintals which do not fulfill the average food and seed demand of household. The major crops grown in the targeted *PA*s include Wheat, Barley, *Teff*, Haricot bean, Lentil and Pea. Regardless of the type of crops, the small land holding size of the inhabitants is further aggravated by very poor and traditional methods of agricultural cultivation systems.

3.1.5.2 Livestock Production

According to the information obtained from Degua Tembein woreda office of agriculture and rural development –livestock department (DTWARLD) although low livestock productivity is a characteristic feature of the studied Tabias, it has been the most dependable source of income and asset for majority of households in the proposed areas. Feed and water shortage are pointed out as the major causes for low livestock productivity. The feed shortage is mainly due to lack of enough grazing land and high number of livestock as compared to the available grazing land. There is no veterinary clinic in the studied Tabias; only one veterinary clinic is found at wereda level. Available sources from the *Woreda* showed that Anthrax, black fly, rinderpest and internal and external parasites are some of the diseases affecting the livestock in the targeted areas where efforts made to improve livestock health are minimal. On the other hand, although the potential for apiculture and poultry is high, the attention given to diversify income through bee-keeping and poultry production is not as much as expected. The bee keeping practice in the targeted areas is mostly traditional and households tend to give attention to multiply and sell the bee colony rather than the product.

3.1.6 Livelihoods of the Study Area

As it is indicated in the Tigray Region Livelihood Summary (TRLS, 2009), the study area is classified as highland (dega) livelihood zone characterized by dry climate conditions and very unreliable rainfall. It suffers from chronic food shortages because it lies in a major drought prone area, whose food security prospects are further thwarted by very infertile soils. Half of the population has a significant measure of self-sufficiency, producing between 75% and 90% of their food. This largely possible because they cultivate over 1-2ha. The main crops cultivated are barely, wheat, teff and lentils. The decision to grow short cycle crops is to some extent influenced by the oftentimes short rainy season .The very poor one –fifth of the population is cultivating roughly 0-1 timads and is forced to purchase over 50% of annual food needs. This

group cultivates very small land because they do not have oxen to provide draught power for land preparation. Their major income sources are precarious. Productive Safety Net Program (PSNP) and labour sales provide approximately a third of income respectively other income sources for the very poor include firewood, limited sales of crop and livestock. Livestock ownership distinguishes the middle and better –off who receive over 75% of their income from livestock sales and livestock product sales combined .The household credit package facilitated very poor and poor household access to small stock purchases that have built some resilience in to their livelihood.

3.2. Methodological Approach

In the assessment and analysis of data for the integrated watershed management program of the Mai Zeg Zeg watershed both the quantitative and qualitative approach was used. For the quantitative approach the propensity score matching was applied and for the qualitative approaches the participatory tools such as focus group discussion, key informant interviews and observation were implemented. These approaches have been developed to help understand and analyze the impact of different programs and policies implemented at different levels such as watershed management programs. Using these two approaches can entertain more options to measure the impact of the integrated watershed management food security projects both on empirical and participatory methods.

3.2.1 The Propensity Score Matching

The aim of matching is to find the closest comparison group from a sample of non participants to the sample of program participants. “Closest” is measured in terms of observable characteristics. If there are only one or two such characteristics then matching should be easy. But typically there are many potential characteristics. This is where propensity score matching comes in. The main steps in matching based on propensity scores are as follows (see Zaid, 2008).

Step 1: Identification of a representative sample survey containing eligible non-participants as well as participants. This study has used a total sample size of 200 out of which 100 are treated (participants) from two kushets of Aynimbirkekin Tabia (Hichi and Adikolkul), one kushet from Tabia Micheal Aby (Harena). The 100 households of eligible non-participants are drawn from three kushets of Tabia Adiazemara namely Tikul, Zerfinit and Tikul ketma. These groups were matched based on the pretreatment characteristics.

Step 2: Pooling together participants and non participants**.** The two samples were pooled .a probit regression was run using participants as a dependent variable and a set of pretreatment variables as explanatory or control variables.

Step 3: Obtaining the probability of participation for each observation**. T**he predicted values of the probability of participation from the probit regression were created. Then it was possible to have a propensity score for every sampled participant and non-participant.

Step 4: Excluding observations that are out of acceptable range **.**Some of the non-participant sample was excluded at the outset because they had a propensity score which was outside the range (typically too low) found for the treatment sample. The range of propensity scores estimated for the treatment group should correspond closely to that for the retained sub-sample of non-participants.

Step 5: Matching observations based on propensity score **.**For each individual in the treatment sample, we found the observation in the non-participant sample that has the closest propensity score. Different matching methods are employed to define the closets match.

Step 6: Obtaining the effect of treatment in the sub-groups. We calculated the mean value of the outcome indicator for the different sup-groups. The difference between

that mean and the actual value for the treated observation is the estimate of the gain due to the program for that observation.

Step 7: Computing the average treatment effect of the entire sample**.** Lastly we calculated the mean of these individual gains to obtain the average overall gain. This can be stratified by some variables of interest such as incomes in the non-participant.

As discussed by *(Zaid, 2008)* as a measure of probability of participation, the propensity score is a continuous variable and we can hardly expect two or more observation to possess exactly the same propensity score. Hence, with exact matching not possible, we resort to inexact matching where we match observations on the basis of closeness of their propensity scores. The four most widely used methods to match observations based on closeness of propensity scores are the stratification matching, nearest neighbor matching, radius matching, and kernel matching.

In ***stratification (interval) matching*** the dataset is divided into intervals with each interval having on average the same propensity score. Treated and control units within that interval of propensity score will be placed under one block and the mean difference of the outcome between the treated and control units will provide the treatment effect for that block. The average difference of all blocks will finally provide the ATT for the entire sample. However, blocks without treated or control observations will not be considered for computing the ATT.

Nearest neigbour matching**,** on the other hand, ensures that each treated observation is considered by matching it with a control observation having the closest propensity score. Hence, for each treated unit, a nearest neigbour is sought from the control unit in terms of its value of propensity score. Here, it is possible that a control unit can be a nearest neighbour for more than one treated observation. After matching each treatment unit with a control unit, the difference in their outcome is calculated and obtaining the average of these differences for the entire sample provides the ATT. Treated observations that do not find a match from control observations within their block will be discarded in stratified matching. In nearest neighbour matching, while it

is possible that control observations can be discarded, each treated observation is considered by matching it with a control observation possessing the closest propensity score irrespective of how far the closeness can be.

Radius matching **and** ***kernel matching*** proffer some solution to these problems. In *radius matching* each treated observation is matched with those control observations that fall within a pre-specified neigbourhood (radius) of the propensity score of the treated observation. Here the size of the radius plays an important role. If it is set to be very small some treated observations may not be considered because they may not find a match from the control. But better matches may be produced with smaller sizes of the radius.

Kernel matching considers all treated and control observations. 'All treated observations are matched with a weighted average of all control observations with weights that are inversely proportional to the distance between the propensity scores of treated and controls.

3.2.1.1 Mathematical Specification of the Propensity Score Matching

$$P = \alpha + \beta D_i + \lambda X_i + \in_i$$

Where

P = propensity score

D = participation dummy

X = control variables

∈i = error term

α, β, λ = Coefficients

$$ATT = \frac{1}{n}\sum_{i=1}^{n}(Y_{1i}|D_i = 1) - (Y_{0i}|D_i = 1)$$

Where

ATT= Average treatment of the treated

Y1i= Outcome of an individual treated by the program (participant)

Y0i= Outcome of non-treated (non-participant)

D= Dummy variable, where D=1 shows participation and D=0 shows non participation

N= Number of observations

3.3. Qualitative tools

In the application of the qualitative tools of the focus group discussion, key informant interview and direct observation, a check list was prepared and based on this proper facilitation was conducted.

Once the information was attained on the participatory basis it was synthesized and summarized so that it could show the views of the participant and non participant on the impact of the watershed based program intervention.

3.4 Sampling Technique

This study has applied a combination of purposive sampling techniques which include non-probability sampling technique, random sampling technique, the convenience and quota sampling methods. The power of purposive sampling in this case lies in selecting information rich-cases (program participants and non participants) for in-depth analysis related to the impact of the watershed management program

being studied, moreover these techniques are preferred because they are convenient for the purpose of the intended impact study.

3.5 Sampling Size and Sample Distribution of the Respondents by Tabia

This study has used a total sample size of 200 households out of which 100 hhs are treated (participants) from kushets of Aynmibirkekin Tabia (Hichi and Adikolkul) , a kushet from Micheal Aby Tabia (Harena) and 100 hhs of eligible non-participants in Adiazemara Tabia from kushets of Tikul ,Zerfinit and Tikul ketma referred as untreated or non participants .Once the study Tabias were indentified purposively the sample households were identified randomly . Because of the fact that the integrated watershed management project was implemented in Aynimbirkekin and Micheal aby Tabias the two Tabias were selected purposively as treated areas on the other hand the Adiazimera Tabia has also selected purposively as non treated area by considering its location, agro ecology and socio- economic similarity without having similar intervention. After the Tabias and kushets were selected purposively the responding households were selected by using random sampling technique. When we see the similarities and differences of the treated and untreated areas, the information obtained from Degua Tembien Woreda office of Agriculture and Rural Development (DWOARD) shows that both of the areas lie under similar topography, have similar soil characteristics, they share common boundaries being in the same Woreda ,on average they also share similar temperature and rainfall patterns ,the two areas know as food insecured areas of the woreda and the vegetation coverage of the areas is similar . On the other hand the total population of the treated Tabias is 12866 (M=6929, F=5937) , out of these population 7377 (M=4075 ,F=3302) are from Aynimbrikekin and 5489 (M=2854, F=2635) are from Micealaby Tabia , and the total population of the untreated Tabia (Adiazemera) is 8868(M=4300, F=4568) and in the treated area the integrated watershed management food

security program implements but in the untreated area there is no such integrate intervention except normal government public interventions. (Table1.shows the spatial distribution of the total sampled households both the program participants and non participants by Tabia.

Table1. Sample Distribution of Respondents by Tabia

Sex	*Tabia*			*Total*
	Aynimbirkekin	*Micheal aby*	*Adiazemera*	
Male	*45* *22.5%*	*29* *14.5%*	*76* *38%*	*150* *75%*
Female	*11* *5.5%*	*15* *7.5%*	*24* *12%*	*50* *25%*
Total	*56* *28%*	*44* *22%*	*100* *50%*	*200* *100%*

Source: Own survey 2009

3.6 Sources of Data and Data Collection

Both Primary and secondary data source were used, and for primary data, the data was collected using the structured household survey questionnaire and the qualitative primary information was acquired using the focus group discussion ,key informant interview and physical observation information. For the secondary data, the watershed profile was prepared based on the data requirements for the concerned sectors of Woreda administration and the information was obtained in the way that it complemented primary data sources and the analysis was done in a similar manner with the primary sources .

3.7 Data Presentation and Analysis

The data collected through field survey was analyzed and presented using STATA as appropriate statistical package for the impact of the program. In measuring the ATT of the program participants the propensity score matching was used. Four matching methods namely, Stratification, Nearest neighbor, Radius and Kernel matching were used. On the other hand the qualitative information collected through FGD, key informant interview and a field observation was also analyzed.

CHAPTER - IV: RESULTS AND DISCUSSIONS

I. Descriptive Statistical Results

4.1 Demographic structure of the respondents

4.1.1 Distribution of Respondents by Tabia and kushet

The descriptive analysis in table1 of the survey respondents showed that 75 %(150) constitute male headed households whereas 25 %(50) of them were female headed households. With regard to their spatially distribution in the study *Tabia*s, 50% (56 and 44) of the households are from Aynimbirkekin and Michael Abiy *Tabia*s respectively and these are the treated group whereas the same proportion are from Adiazemera where the integrated natural resources management and food security program was not implemented and hence constitute the untreated (control group).

With regard to the spatial distribution of the respondents within the *Kushet*s of each *Tabia*, it was observed that the highest figures of both male and female respondents were found in Tikul kushet from Adiazemera Tabia (*28.5%)* and Harena kushet from Michealaby Tabia (*22%)* and the lowest are in Debremizan (12%) and Tikulketema (8.5%) in Aynimbrikekin and Adiazemere *Tabia*s respectively (table 2). This was happened due to the fact that the more the population size in Tabia the higher the representation of the respondents .To this regard once the study Tabias were selected purposively the number of the respondents in the entire kushets were decided on percentage and quota basis based on the total number of population in each Tabia and kushets. Lastly the specific respondent was selected using simple randomization.

Table2- Distribution of Respondents by Kushet

Tabia	*Kushets*	*Male headed households*	*Female male headed households*	*Number of total respondents*	*Percent*
Aynimbirkekin	*Hitchi*	*25*	*7*	*32*	*16*
	Debremizan	*19*	*5*	*24*	*12*
Micheal aby	*Harena*	*29*	*13*	*44*	*22*
Adiazemera	*Tikul*	*42*	*15*	*57*	*28.5*
	Zerfitin	*19*	*7*	*26*	*13*
	Tikulketema	*14*	*3*	*17*	*8.5*
Total		*150*	*50*	*200*	*100*

Source: Own survey 2009

4.1.2 Age of the respondents

The survey results in table3 showed that the age category of the respondents ranges from 20 to 80 years and the mean average age of the respondent household heads is 45.6 with St.dev of 11.95 both in the treated and untreated areas. The survey result also showed that the mean age of the male respondents was 45.95 years and the female respondents mean age was 44.6 years.

Table3. Mean age of the respondents

Variable	Obs.	Mean	Std. Dev	Min	Max
Hhage	***200***	45.615	11.95329	***20***	***80***

Source: Own survey 2009

4.1.3 Mean Household family size in the two areas

The survey results of the respondents in table3 showed that the total family size in both treated and untreated areas ranges from 1 up to 10. The survey result also showed that a mean family size of 5.215 with a standard deviation of *2.037038* in both areas. With regard to sex disaggregated results the survey showed that the male headed respondents have a mean family size of 5.7 and the female headed household with mean family size of 3.76. On the other hand when we see the mean family size of the respondents by area the respondents in the treated areas have a mean family size of 5.45 and the respondents in untreated areas have a mean family size of 4.98. This implies that the treated areas are more densely populated than the untreated areas, more over the family size in treated area exceeds the regional average family size of 5 (BoFED ,2003).

Table4. Mean Household family size in the two areas

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Tfsize	*200*	*5.215*	*2.037038*	*1*	*10*

Source: Own survey 2009

4.1.4 Educational Status of Respondents

The survey results showed that from the interviewed household heads both male and female 58 %(116) cannot read and write and the 42 %(84) can read and write (table5).

Table5. Read/write status of the respondents

Read/write status of The respondents	Male headed	Female headed	Total	Percent
Yes	*79*	*5*	*84*	*42*
No	*71*	*45*	*116*	*58*
Total	*150*	*50*	*200*	*100*

Source: Own survey 2009

When we see the educational status of the respondents the survey results revealed that the household heads both male and female 58% (116) are illiterate ,12.5% (25) traditional (Nay keshi Timhirit),25%(50)elementary incomplete ,1.5% (3) elementary complete, 2.5% (5)secondary incomplete and only 0.5%(1) is secondary complete. With regard to sex disaggregated educational status of the interviewed households the survey result showed that 90% (45) of the female headed and 47.33 %(71) of the male headed respondents were illiterate (table6).

Table6. Educational Status of Respondents by sex

Educational status of the household head	Sex of the household Head		Total
	Male	*Female*	
Illiterate	*71*	*45*	*116*
Traditional	*24*	*1*	*25*
elementary incomplete	48	*2*	*50*
elementary complete	*3*	*0*	*3*
secondary incomplete	*3*	*2*	*5*
secondary complete	*1*	*0*	*1*
Total	*150*	*50*	*200*

Source: Own survey 2009

4.1.5 Committee membership of the household heads

When we see the committee participation of the household heads, the descriptive analysis of the survey respondents of both the treated and untreated areas of both sex showed that 23% (23) in the treated area have some form of committee membership and 28% (28) in the untreated area have also formed some committee membership. The sex wise distribution of the committee membership in both areas showed that 45 of the male headed households are participating in some form of committee membership and only 6 of the female headed households are participating in some form of committee membership. This further shows that the women participation in committee membership and decision making is still low.

II. Analytical Results

4.2 Impact on household income, productivity and production: Empirical Analysis

The analysis of this part is based on household survey data collected through the structured questionnaire from three Tabias of Degua Tembein Woreda namely Anymbirkekin, Micheal aby and Adiazemera .The two Tabias of Anymbirkekin and Michealaby are treated areas where 100 household heads (treated group) were interviewed whereas the Adiazemara Tabia is untreated area in which another 100 non participants (control group) household heads were interviewed. Our unit of analysis was the household. We have used the following variables to estimate the impact of the program on food security at household level: average income level , average production per tsimidi in quintal, total cost of fertilizers used in Birr, number of months a household can feed from own production ,average livestock holding and use of selected seed variety(wheat).

4.2.1 Results and Discussion

In the propensity Score matching (PSM) method of generating average treatment effects on the treated, the first step is to estimate the propensity score using control variables for each observation. The propensity score measures the probability of participation given a set of pretreatment control variables. The control variables used in obtaining the propensity score are those household characteristics not affected by program participation. The probability of participation is thus estimated using these control variables that describe household characteristics. The probit estimation of the propensity score for the sample containing treated and control observations is shown in Table7.

Table7. Probit Estimation of the propensity score

Cont.vaiab	Coef.	Std. Err.	z	P>z
hhage	.0938844	.0639637	1.47	0.142
agesq	-.0006638	.0006499	-1.02	0.307
hhlit	.3060871	.2337716	1.31	0.190
TLhol	-.473648	.079483 ***	-5.96	0.000
tfsize	.2233043	.062118***	3.59	0.000
comem	.013686	.2477839	0.06	0.956
_cons	-2.553438	1.418443*	-1.80	0.072

Number of obs	=	197
LR chi2(6)	=	56.16
Prob > chi2	=	0.0000
Pseudo R2	=	0.2056

***=significant at1% *=significant at10%

Note: The balancing property is satisfied**.**

Control Variables: In this model we have used the following control variables: 'age of household head' 'age square of household head' , 'household head literacy', 'Total landholding of the household head ,' 'total family size of the household head' and , 'household head committee membership' of the respondent household .

Once the propensity score is determined and the balancing property is satisfied, the next step is to match the observations based on their propensity scores and estimate the average treatment (ATT) effect of the treated. This is done using the impact indicators which are used to measure impact.

The four matching methods used to obtain ATT are: Stratified matching, Nearest neighbor matching, Radius matching and Kernel matching.

4.2.2 Estimated ATT Results

Table8 shows estimated results of ATT for different impact indicators of the food security program .Average Household income is calculated from total income which is the sum total of income from petty trade, household enterprise, handcraft, wage other than productive safety net, income from productive safety and beekeeping .The average production per tsimidi is the mean sum of rain fed production pertsimidi and the irrigation production pertsimidi. The average costs of fertilizer include cost of DAP and Urea fertilizers used per household per tsimidi for different crops. The averages numbers of months a household can feed his family from own production indicates that how many months are actually covered by own production in both the treated and untreated areas. The average livestock holding of household indicate that, on average how many livestock are owned by the households in both the study areas and this includes the average ox holding. In measuring the total livestock holding the tropical livestock unit (TLU) was used as a conversion factor so that all the livestock owned could be explained in meaning full unit of measurement. Lastly the average selected wheat variety indicates that the selected wheat seed variety that is used by respondents in both areas. This was taken as indicator because the survey results showed that the selected seed used in the area is only wheat.

Table 8. Estimation of ATT using Propensity Score

Impact Indicator	Matching method	ATT	Std.Err	t
Household income	Stratification	566.170	141.321	4.006***
	Radius	536.458	156.385	3.430***
	NearestNeighbor	340.098	178.158	1.909*
	Kernel	465.005	208.543	2.230**
Land Productivity	Stratification	0.650	0.518	1.254
	Radius	1.879	0.403	4.667 ***
	NearestNeighbor	2.418	0.715	3.382***
	Kernel	2.350	0.700	3.355 ***
Cost of fertilizer	Stratification	63.726	30.886	2.063**
	Radius	96.585	34.173	2.826***
	NearestNeighbor	106.730	43.469	2.455**
	Kernel	106.076	41.273	2.570**
No.Of months fed from Own production	Stratification	0.600	0.339	1.769*
	Radius	1.240	0.363	3.414***
	NearestNeighbor	1.596	0.319	5.000***
	Kernel	1.620	0.348	4.653***
Selected wheat production	Stratification	1.090	0.189	5.775***
	Radius	1.189	0.184	6.460***
	NearestNeighbor	1.196	0.177	6.756***
	Kernel	1.211	0.228	5.314 ***
livestock holding (in TLU)	Stratification	-0.938	0.194	-4.838***
	Radius	-0.693	0.213	-3.00***
	NearestNeighbor	-.353	0.264	-1.340
	Kernel	-0.431	0.226	-1.904*

***=*significant at 1%* **=*significant at 5%* *= *significant at10%*

While estimating ATT for the different impact indicators of food security the estimation is done through matching of treated and control observations. In three out of the four matching methods, the treated group contains 100 observations except the

radius matching which contained 98 observations. On the other hand the control observations were 100 in stratified and kernel matching but in radius and Nearest Neighbor matching they were 99 and 41 respectively. Estimated results showed that ATTs are significant for all the selected and analyzed food security impact indicators except the average livestock holding where the result does not look like very robust. Based on the four matching results the ATTs results are analyzed as follows.

Gain on household income (income from sources other than crop production): The matching results showed that the program participants have enjoyed an average gain in the total household income between ETB 566.170 and ETB 340.098.This shows that the program participants are diversifying different income sources for their livelihoods. When we see these values in terms of significance all the matching methods showed significant results.

G**ain in Land productivity per tsimidi:** The matching results showed that the program participants have benefited with an average production gain in total production per tsimidi between 2.418 and 0.65 quintals. This happened due to increase in the land productivity which resulted from intensive soil and water conservation measures which were constructed by the watershed management food security program on cultivable land and accompanied with moisture holding in past five years . Other contributing factor for increase in production is that in the treated areas due to increase in water discharge and water flows the program participants are practicing irrigation. In figurative terms 13% of the program participants are using irrigation in their farm lands, while 0% of the non participants irrigate their land. With regard to the significance of the results the three matching methods of Radius, Kernel and nearest neighbor showed significant results. The radius, kernel and nearest neighbor matching have showed an average gain in total production by 1.879, 2.350 and 2.418 quintals per tsimidi with Std.Err of 0.403,0.700 and 0.715 respectively . The result of Stratification matching resulted with average gain in production by 0.650 quintal and Std .Err of 0.518 which does not show any significance.

Cost of fertilizer: all of the four matching method results showed that the participants spent more money on the two types of fertilizers namely DAP and Urea. The participants on average spent Birr 106.730 and Birr 63.726 more on fertilizer compared to non participants. When we see the significance of the results the four matching results show that significantly the participant are spending more money for fertilizer so that the return on production will be high. This further implies that the land productivity and moistures holding in treated areas are better than the untreated areas. Other implication of the increased average cost of fertilizer for the participants is that they have gained more purchasing power of agricultural inputs like fertilizer. The stratification, radius nearest neighbor and kernel matching results showed ATT of Birr 63.726, 96.585, 106.730 and 106.076 with Std,Err of 30.886 ,34.173,43.469 and 41.273 respectively .

N**umber of months a household can feed his/her family from own production:** The matching results showed that the program participants have a gain of feeding their family for more months from own production. On average the participants have gained a benefit of feeding their families for extra months between 0.600 and 1.620 months. The program participants are able to achieve this mainly from the increased production and total average income. All the matching methods showed significant gain for program precipitants.

Selected Wheat Variety Use: The matching results showed that the program participants have benefited with an average production gain in selected wheat variety production per tsimidi between 1.090 and 1.211 quintals. This resulted due to the awareness of the program participants and improved soil fertility of the treated areas .With regard to the significance of the results stratification, radius nearest neighbor and kernel matching results showed average production gain of 1.090,1.240,1.596 and1.211 with Std .Err of 0.189,0.184,0.177 and 0.228 respectively . This result show significance gain on production due the use selected wheat variety.

Livestock holding: The ATT for livestock holding shows significant gain for the non participants with average livestock holding between 0.353 and .938 TLU. The results

of the stratification and radius matching show that the non participants made gain of 0.938 and 0.639 TLU respectively and these results are statistically very significant. On the other hand the kernel matching result shows a gain of 0.431 TLU and this is also significant but the result of the Nearest neighbor matching shows a gain of 0.353 TLU, this does not show any significance. One can therefore say the program participants do not made any gain out of the livestock holding. When we see the contribution of the program to this fact, the integrated watershed management program in Mai zeg zeg watershed promotes less livestock holding but emphasis on the quality and productivity of the livestock. Similarly the program promotes the grass cut and carries system which discourages the livestock mobility and number .This is done to limit more grazing and it further facilitates the environmental rehabilitation. Therefore the program participants are inclined to hold less livestock so that the quality could be assured and the livestock productivity increased.

III: Environmental Impact

In this part we have tried to see the impact of the integrated watershed management food security program on the environment .The program has many interventions which were intended to improve natural resource rehabilitation. Some of the interventions include soil and water conservation measures, area closure and tree plantation. This study tries to focus on the change that is recognized or felt by the respondent households or it tries to capture the environmental impact of the program by view of the responding households and it does not try to measure the environmental impact using any technical measures. Therefore it only focuses to capture the impact based on the perception of the surveyed households. The analysis of this part is mainly based on the descriptive finding of the survey, the FGD and observation with some photos.

4.3.1 Types of Environmental Change in the Study area.

The household survey results in table9 shows that the project participants and non participants in both the treated and untreated areas have observed many environmental changes .Some of the environmental changes which are observed by the respondents include soil erosion ,deforestation ,expansion of bad land ,shortage of water and gully formation . In figurative terms the program participants responded that 94% of have observed soil erosion, 4% shortage of water and 2% deforestation. On the other hand the non participants responded that 50% observed soil erosion, 30% gully formation, 11% deforestation, 8% shortage of water and expansion of bad land. From this analysis we can understand that the problem of soil erosion and gully formation are critical problems in the study area. The information obtained from the FGD supports this fact. The participants of the FGD said that the rate of soil erosion and gull formation is very critical.

Table9. Responses on the environmental change

Environmental change	Treated	%	Untreated	%	Total
Soil erosion	94	94	50	50	144
Deforestation	2	2	11	11	13
Expansion of bad land	0	0	1	1	1
Shortage of water	4	4	8	8	12
Gully formation	0	0	30	30	30
Total	100	100	100	100	200

Source: Own survey, 2009

With regard to the rate of land degradation the survey result in table10 shows that the rate of land degradation in the untreated area has significantly reduced. But the rate of land degradation in the untreated area did not show significant change. To this regard the FGD participants in the treated area have witnessed that there is good progress towards reduction of the land degradation. The FGD participants in treated areas further said that the watershed management program at Mai zeg zeg watershed has contributed a lot though the construction of soil and water conservation measure across gullies and hillside of the watershed .

According to the FGD participants in the untreated area they said that in their area they do not have a separate integrated watershed management food security program which intervenes in the rehabilitation of the natural resources conservation. The participants further said that there are huge gullies elsewhere in the Tabia that need special treatment through integrated watershed management approach by supplying industrial materials and skilled labor to construct structure that can reduce land degradation. On the other hand the participant admitted that they conduct soil and water conservation structure with their free labor and the productive safety net

program resources as public works that is run by normal government interventions, but due to the fact that these programs lack proper integration and continuity the land degradation in the untreated are did not show significant change.

In figurative terms the survey result shows 94% of the program participants responded that the land degradation is decreasing, 3% said there is no change and 3% said the land degradation is increasing fast. With regard to the non participants 57% responded that there is no change with the land degradation, 41% said the land degradation is decreasing, 1 % said it is increasing and another 1% knows little about land degradation. The descriptive results supports the idea raised by the FGD participants in the two areas, because the result of the land degradation in the treated areas show significant reduction (94%),where as the result (41%) of the untreated areas do no show such reductions .

Table10. Responses on the rate of land degradation

Rate of land degradation	Treated	%	Untreated	%	Total
0	0	0	1	1	1
Increasing fast	3	3	1	1	4
No change	3	3	57	57	60
Decreasing	94	94	41	41	135
Total	100	100	100	100	200

Source: Own survey, 2009

4.3.2 Household Participation in Soil and Water Conservation and Tree planting

The focus group discussion participants of the two areas (treated and untreated) have said that people of the study area participate in all public works like SWC and tree

plantation and they further said the participation is not always on payment basis . The survey results of the respondent households in both areas support this fact. 98% of the participants and 94% of the non participant have responded that they would voluntarily participate in activities of SWC and tree plantation activities. This implies that the inhabitants of both the treated and untreated area are well informed about environmental protection. With regard to tree plantation 98% of the program participants and 88% of the non participants responded that they have participated in tree planting for the last five and more years. This implies that the program participants and non participants are almost equally participating in soil and water conservation and tree planting activities.

4.3.4 Changes Observed

Survey result in table11 shows that there are two major benefits obtained from natural resource management in the study area. The two major benefits gained from the natural resources management are increased vegetable coverage and increased water discharge in down streams of the constructed SWC measures. In terms of percentage 96% of the program participants responded that vegetation coverage and water discharge in down streams of the constructed SWC measures increased and the 4% do not seem to know about the change .With regard to the non participants 67% responded only the vegetable coverage increased and 33% do not seem to know about the change.

The FGD participants in the treated area support the idea that in their locality due to the integrated watershed management program there is increased vegetation coverage. According to the participants the increased vegetation coverage was facilitated due to the area closure practice. Due to the increased vegetation cover animal fodder increased and bee keeping activities expanded. Similarly the FGD participants in the same area responded that due to the intensive SWC works and gully reclamation supported by skilled laborers and gabion mesh wires there is a remarkable change in protecting arable land which resulted in moisture holding and increased water discharge in down

streams of the constructed structures . Figure 9&10 in annex I shows the gully protection during treatment and after treatment which showed a significant result .According to the discussion participants 2/3 of the arable and ¾ public land was conserved and this caused increased land productivity per ha in the treated areas.

With regard to the untreated area the FGD participants said that there is increased vegetation coverage which mainly resulted from the area closure. Regarding the other change like increased water discharge in downstream of the constructed SWC measures they said we simply do SWC on small scale on the public and private land but the big eroded gullies are beyond our capacity, because reclaiming these gullies require huge amount of skill and industrial inputs and due to this fact there are big gullies in their locality that need special treatment. The participants of the FGD in the untreated areas further said due to the existence the serious soil and gully erosion their farm lands are at risk ,causing reduced land size and poor soil fertility which resulted in reduced land productivity per ha.

Table11. Responses on changes due to natural resource management.

Changes due to natural resource management activities	Treated	Untreated	Total
0	4	33	37
Vegetation coverage increased	51	67	118
Water discharge increased	45	0	45
Total	100	100	200

Source: Own survey, 2009

When we see the irrigation usage of the study area the survey result in table *Table 12(1=yes and 2=no)* shows that in the treated area 13%of the respondent are practicing irrigation but none of the non- participants are using irrigation . This result goes in

line with the survey result on table11, which states 45% of the program participants responded that Water discharge increased in the down streams of the contracted SWC structures in treated areas. The FGD result of the program participants in the treated area also supports the idea that there are a number of households practicing irrigation from reemerged spring as resulted of the SWC structures. The FGD participants further mentioned the irrigation area around 'zenako' is reemerged as result of SWC measures which were constructed in the upper streams of the reemerged spring at 'zenako' which currently serving as irrigation water source for surrounding households. Figure11 in annex I shows an area where new springs emerged in the down streams of the soil and water conservation structures constructed in the past five years by the integrated Mai zeg zeg watershed management program where 9 households practicing irrigation which helped them to produce more than one harvest.

Table12.Responses on irrigation use

Irrigation use	Treated	Untreated	Total
Yes	13	0	13
No	85	98	183
0	2	2	4
Total	100	100	200

Source: Own survey, 2009

4.3.5. Economic Benefits Gained from Watershed Based Natural Resource Conservation Activities

The survey response results in table13 shows that the households both in the treated and untreated areas getting different benefits out of the watershed based natural resource conservation activities. To mention some of the benefits inhabitants are

benefiting from grass cut and carry, honey production, increased water availability, wood and improved environment.

In figurative terms 45% of the program participants responded that they use grass cut and carry (figure 12 &13 in annex I shows sources of grass and grass cut and carry respectively), 19% said that they are benefited from increased water availability, 29% said they benefited from improved environment, 4% benefited from honey production ,2%benefited from wood and 1% know nothing about the benefit.

With regard to the non participants 5% responded that they use grass cut and carry, 60% said they benefited from improved environment,3% benefited from honey production ,1%benefited from wood and 31% know nothing about the benefit.

Table13.Responses on Economic benefits gained from watershed based natural resource conservation activities

Benefits from watershed based conservations	Treated	Untreated	Total
0	1	31	32
Grass cut and carry	45	5	50
Wood	2	1	3
Honey production	4	3	7
Improved environment	29	60	89
Increased water availability	19	0	19
Total	100	100	200

Source: Own survey, 2009

During the FGD of the treated area it was raised that program participants are enjoying different benefits out of the watershed based natural resources conservation. In the discussion the participants mentioned that since the watershed management program started they recognized major economic benefits that include, increased land productivity and crop production, increased honey production, increased animal fodder production, increased water availability.

According to the FGD participants in treaded areas the land productivity is increased due to the construction of the SWC measures on the farm land, it led to moisture holding. At the same time the crop land was protected from animal interferences, this reduced soil compacting, these all increased the soil fertility and then increased land productivity. In justifying the fact the participants said in their area before the program the crop production per ha was less than 3quintal but now on average production per ha reached 10quinlats. Similarly the area closures are serving in maximizing honey production (figure14) and animal fodder production in this regard the participants said there is a remarkable achievement. With regard to the increased water availability it benefited them in increased water coverage by dinging hand dug wells at their proximity allowing them to travel 30 minutes only. The increased water discharging also helped them to increase crop production though irrigation.

The FGD participants of the untreated area said the economic benefit gained from the conserved areas area only recognized in terms of honey production and to some extent crop production. This could happen due to the fact that there is no organized integrated watershed management program in their areas. Especially the discussion participants said that they are really looking for a means that can solve the serious problem of water shortage and gullies erosion which is threatening their livelihoods.

4.3.6 Sustainability of the Watershed Based Natural Resource Management Activities.

Even though "Participation" means different things to different people (*German et.al. 2006*) the sustainability of the watershed based natural resource management activities

highly depends on participation of the community members in the establishment of the bylaws that governs the use of the activities. On the other hand if the bylaws do not bring equity and benefits to the local people the sustainability of these activities will be compromised. The bylaws must accommodate representation of the community sections from lower up to the highest levels in the decision making process.

The finding of the FGD in both the treated and untreated areas reflects some gaps in fulfilling the above principles in the study areas. The participants of the FGD in the treated area said that most of the bylaws established to govern the NRM activities are not effective and the reasons were raised as, insufficient consultations, are not accompanied by economic gains, and lacks sense of ownership.

For example the bylaws established to govern area closers and SWC measures are not effective According to the FGD participants the continuity of the area closure depends on guarding. Currently the guarding is done by paying salaries to the guards and the payment is made on cost sharing bases some part is paid by the project and some other part is made from productive PSNP. The FGD participants were quite unclear about the continuity of the areas closures once the payment is stopped. Moreover there was no clarity on sharing the benefits. On the other hand some of the FGD participants sated that the concept of area closer discourages animal production. Based on this finding, despites its multiple roles in the environmental rehabilitation and improvement the sustainability of the area closures in the treated areas are questionable.

When we see the issue of the SWC structures constructed in the communal and private lands in the treated areas the FGD participants disclosed that there is no clear procedure on how to maintain and sustain these structures. This indicates that some observable impact of the environment may be affected. Because we have seen that there is increased land productivity and increased crop production due to the impact of

these structures. To this regard the sustainability of these structures is again questionable.

With regard to the untreated areas the FGD participants has better awareness on the continuity of the areas closures and maintenance of the SWC structures. The participants said that the area closures are established by their own initiative and they will not look to any external body to sustain the activity and they will continue guarding it without any payment so that the community will not lose the current benefit. They also disclosed that the SWC structures will be maintained by their free labor. This shows that the untreated group is free of the dependency on external body and the small benefit they have is acquired through their participation and there is an indication of the continuity of what they have, this further implies better sustainability of those activities.

IV: Water Coverage and Related Indicators

In the context food security water takes lion's share both at food production and household consumption level and in the analysis of this part we have tried to see the potable water coverage and related indicators of Mai- zeg zeg watershed management program at household level.

4.4.1 Access and Sources of Safe Drinking Water in Both Areas

The survey results of the respondents of water access as indicated in table14 (1=yes, 2 No) showed that the project participants have much better access than the non participants. To this end 93% of the project participants have responded that they have access to clean water source but none of the no participants have responded that they have access to clean water source. On the other hand 7% of the project participants have not access to clean water source and 99% or almost all of the non participants do not have access to clean water sources.

Table14. Responses on access to clean water sources in the study area

Responses on access to clean water sources	Treated	%	Untreated	%	Total
Yes	93	93	0	0	93
No	7	7	99	99	106
No response	0	0	1	1	1
Total	100	100	100	100	200

Source: Own survey data 2009.

When we see the responses of the surveyed households on source of drinking water or type of water sources that they use table15 indicates that the program participants have safer options or sources to fetch water than the non participants. In figurative terms the participants use 8%, 78%, 13%and 1% from unprotected spring, Hand dug well,

Protected spring and tap water respectively. On the other hand the non participants use 4%, 77%, and 19% from river, unprotected spring and pond respectively. The information obtained from the focus group discussion (FGD) supports that all the participants of FGD in the untreated area have witnessed that the sources of drinking water in most parts of the PA is unsafe and far to reach and fetch water. The FGD participants further says that the sources of water for livestock and human are the same. This implies that the program participants have safer water sources than the non participants.

Table15. Responses on source of drinking water in the study area

Source of drinking water	Treated	%	Untreated	%	*Total*
River	0	0	4	4	4
Unprotected spring	8	8	77	77	85
Pond	0	0	19	19	19
Hand dug well	78	78	0	0	78
Protected spring	13	13	0	0	13
Tap water	1	1	0	0	1
Total	100		100		200

Source: Own survey data 2009.

4.4.2 Estimated Results on Average Time to Fetch Water and Average Number of Liters a household Consumes per day

The two water impact indicator variables for this section are selected to measure the average distance walked by the household to reach the nearest water point and to

know how much average liters of water are utilized for house consumption purposes by a household both in treated and untreated areas. Table16 shows the matching results of the four matching methods namely stratification, radius, nearest neighbor and Kernel. The matching results of two water impact indicators are analyzed below as follows:

Table16. Estimation of ATT using Propensity Score

Impact Indicator	**Matching method**	**ATT**	**Std.Err**	**t**
Ave .Total time to fetch	Stratification	-119.277	18.311	-6.514***
Water	Radius	-118.024	16.659	-7.085***
	NearestNeighbor	-105.960	30.890	-3.430***
	Kernel	-120.914	24.631	-4.909***
Ave.No. of liters/day	Stratification	3.200	1.802	1.776*
	Radius	2.171	2.001	1.085
	NearestNeighbor	4.353	2.573	1.692 *
	Kernel	2.654	2.374	1.118

***=*significant at 1%* *= *significant at10%*

Average total time taken by a household to fetch water: Matching results showed that the non- participants need more time to reach the water point and fetch water. The non participants need on average an extra time between105.024 and 119.277 minutes with Std.Err of 30.890 and 18. 311. This happened due to the limited intervention to develop water points in the untreated areas. With regard to the significance of the results stratification, radius , nearest neighbor and kernel matching results showed an average extra time of 119.277,118.024,105.960 and 120.914 minutes with Std.Err of 18.311,16.659,30.890and 24.631 respectively. These results are quite

significant and it shows the non participants are under severe problem of water shortage. On the other side the program participants have more access to water points and gained a significant benefit of average walking time to reached the water point. Because the participants have to walk 67.9125 minutes to reach the water point and fetch water but the result shows that the program participants are still below the international standard of walking 30 minutes to fetch water.

Average number of liters a household consumes per day: The matching results showed that the program participants have not made any significant gain on water utilization. On figurative terms they made average consumption between 2.171 and 4.353 liters per/day .On the other hand when we see the significance of the results stratification, radius , nearest neighbor and kernel matching results showed an average water consumption of 3.200, 2.171, 4.353 and 2.654 liters with Std.Err of 1.802 , 2.001 , 2.573 and 2.374 respectively. These results show quite low gain or insignificant gain as the ATT is significant in only 2 of the 4 matching methods with 10% level of significance. This further implies that the program participant have much better access to water points but their water utilization is much below than the international standard set by United Nations Children Fund (UNICEF) and World health organization (WHO) 10 and 20 liters of household water consumption respectively .

4.4.3 Water Treatment before Use

Water treatment before is one of the important factors which contribute to the healthy water consumption of rural households. Table17 indicates the types of filtrations being used by the surveyed households both in the treated and untreated areas. Survey results of table17 shows that more people are using water treatment before use in the untreated area than the treated areas. From the untreated respondents 1%, 1% and 27% wuha agar, filtering and sedimentation respectively and 2%and 1% use boiling and filtering in the treated areas. On the other hand in both areas significant numbers of households (97 % treated and 71% untreated) do not use any water treatment before use. As it was indicated in the FGD more people do not use water treatment in the

treated area is that they believe their water is clean but in untreated areas people do try to treat water before use thinking that their water sources are unsafe.

Table17. Response on water treatment before use

Water treatment before use	Treated	%	Untreated	%	Total
Wuha agar	0	0	1	1	1
Boiling	2	2	0	0	2
Filtering	1	1	1	1	2
Sedimentation	0	0	27	27	27
No treatment	97	97	71	71	168
Total	100		100		200

Source: Own survey data 2009.

4.4.4. Major Benefits from Current Water Supply

The household survey results in table18 shows that the project participants in treated areas are enjoying the major benefits such as time saving ,health improvement and more water for different uses from the current water supply system .But when we see the non participants in this regard ,the major benefits in the untreated areas are much minimum . The survey result shows that out of the project participants 72%, 13% and 7% are enjoying major benefits of health improvement, time saving and water for more uses respectively. On the other hand the non participants are not gaining such benefits from current water supply system in the untreated areas, in figurative terms 89% responded that they do not have any gain from the current water supply and infarct 8% and 3% gain benefits in time saving and using water for different uses respectively. In terms of gain this is extremely insignificant gain for the non *participants.*

Table18. Responses on major benefits from current water supply

Major benefits from water supply	Treated	%	Untreated	%	Total
0	8	8	89	89	97
Time saving	13	13	8	8	21
Health improvement	72	72	0	0	72
More water for different uses	7	7	3	3	10
Total	100		100		200

Source: Own survey, 2009

When we say that the water points are accessible to the rural households implicitly it means that the households are getting more time for other uses, therefore in this part we are trying to see how the responding households are using the extra time for productive purposes so that their food security status can be improved. As it is indicated in table19 the survey results shows that the program participants have more extra time for other uses, based on this from the participants 22%, said that their extra time is allocated for schooling, 20 % said they use for child caring, 19% use for rest, 14% for socializing, 11% responded their extra time is spent on income generating activities and the 14% responded that they do not have extra time that is remained from water fetching. With regard to the non participant only 8% and 1% use the extra time for socializing and income generating activities, but the 91% responded that they do not have extra time left from water fetching. The information obtained from FGD in the untreated area supports the fact that the non participant spent from 3 to 6 hours in water fetching.

Table19. Responses on use of Extra time.

Extra time use	Treated	Untreated	Total
0	14	91	105
Schooling	22	0	22
Earn income	11	1	12
Care children	20	0	20
Socializing	14	8	22
Rest	19	0	19
Total	100	100	200

Source: own survey, 2009

4.4.5. Current water quality compared to past five years and incidence of water borne disease

In this session we have tried to assess the trends of potable water quality in the past five years and the related impact on the water borne disease. In the FGD it was pointed out that the water quality has direct relationship with health status of the households. The water bore disease also has a direct correlation with water quality that is consumed by a given individual. As it is depicted in table20 the surveyed households in treated area responded that the quality of potable water in the past five years has been improved significantly. To this end 93% of the program participants have responded that since the past five year the water quality was good but 7% of the program participants responded as there is no change in the water quality. On the other side 89% of the non participants have responded that the water quality is poor, 10% said there is no change observed, and 1% said the water quality is improved or good.

Table20. Reponses on water quality compared to past five years

Water quality	Treated	Untreated	Total
Good	93	1	94
Poor	0	89	89
No change	7	10	17
Total	100	100	200

Source: Own survey, 2009

With regard to the incidence of waterborne disease the survey results in table21 shows that there is significant reduction of water borne disease in the treated area but respondents of the untreated areas knows little about the distinction between water borne and other similar diseases . In figurative terms 78% of the program participant responded that there is significant reduction in the incidence of waterborne diseases, 1% said there is a moderate reduction, 1% said there is no reduction and the 20% said they know nothing about waterborne disease. 99% of the non participants responded that they know little about water borne diseases and the1% responded it not reduced.

Table21. Responses on incidence of water borne disease

Incidence water borne disease	Treated	Untreated	Total
0	20	99	119
Significantly reduced	78	0	78
Moderately reduced	1	0	1
Not reduced	1	1	2
Total	100	100	200

Source: Own survey, 2009

4.4.6. Sustainability of Water Points in Treated and Untreated Areas

In FGD it was pointed out that the sustainability of the water points are highly determined by the existence of the functional water management system. During the FGD discussion the participants of the two areas have emphasized that the water management system can be effective if the following factors are fulfilled. The main factors which were raised during the discussion include effective water fee system and the maintenance of water points. Based on the survey result household responses in table22 showed that 93% of the treated said that they pay water fee and 7% responded that they do not make any fee on water. With regard to the non participants 75% responded that they are paying for water, 20 % do not pay water fee and 5% do not know anything about water fee.

Table22 Response on water fee

Water fee	Treated	Untreated	Total
0	0	5	5
Yes	93	75	168
No	7	20	27
Total	100	100	200

Source: Own survey 2009

When we see the responses on water point maintenance in table23 the survey results showed that all the program participants in treated areas are exercising the water point operational maintenance. As it was pointed out in the FGD in the treated areas the water users conduct the maintenance through their efforts and by external assistance like government and NGO. The survey result showed that 69% of the respondents said that the maintenance is conducted by trained community members, 18 % said it is conducted by private technicians, 5% said it is conducted by government, and 1%

responded by NGO. In the FGD the participants said that even though the maintenance is conducted it is delayed and they further said after the program phase-out they hesitate that the maintenance may not be conducted at all. This indicates that the sustainability of the water points in the treated areas is not yet achieved.

With regard to the non participants even though they are contributing water fee the maintenance does not conducted by any party. According to the survey 98% of the respondents in untreated area said that water point maintenance does not conducted and only 2% responded that the trained community members maintains the water point. The FGD participants from the untreated area said the inaccessibly to water points are aggravated by different factors such as low water coverage and limited maintenance of the existing few un functional water points.

Table23. Response on water maintenance

Responses on water point Maintenance?	Treated	Untreated	Total
0	7	98	105
Government	5	0	5
NGO	1	0	1
Trained community members	69	2	71
Private Technicians	18	0	18
Total	100	100	200

Source: Own survey 2009

V: Problems Associated with Watershed Management Approach

The analysis of this part mainly depends on the findings of the focus group discussion (FGD) and key informant interviews results .The FGD was conducted in the treated and untreated areas separately so that the views of the FGD participants towards the problems encountered in watershed approach of both areas could be entertained. The

key informant interview was conducted in both area at Woreda and Peasant Association with the key individuals who have better information about this issues. The information obtained from the two sources is summarized as follows:

1. **The watershed approach excludes administrative boundaries**

   The information obtained from the two sources discloses that the current administrative structure of the government runs development activities based on the Woreda, Peasant Association and kushet. On the other hand watershed follows natural boundaries following watershed as a result the participants in the untreated areas claimed that they are excluded from the development activities. Discussants of the treated areas also witnessed that some kushets of the same peasant association are excluded while some included in to the watershed development activities. Based on this the discussion participants suggested that the watershed approach must have flexibilities to accommodate some administrative variations.

2. **The watershed lacks data on a given watershed base**

   The FGD and key informant interview discussion participants said that all the government structure records data on the basis of the administrative boundaries, due to this fact there is no data on watershed basis in most areas. Therefore it is difficult to get data on watershed basis and conduct development interventions at watershed levels. To this end they advised all the interventions made at watershed level must give due emphasis to capacity building of the local development actors and administrative bodies so that they could able to make recording at watershed basis.

3. **The watershed approach is not yet institutionalized**

   According to the discussion participants most of the watershed based activities and bylaws are not effective or the bylaws are over guided by existing ones and this is due to the fact that the approach is not yet institutionalized**.** Furthermore they said that if this approach was institutionalized and all the

activities were accounted this may solve other similar problems around the watershed approach.

4. **It is difficult to monitor on watershed basis**

   The participants disclosed that as the approach follows natural boundaries and data is not recorded or available on the watershed basis and it made difficult to monitors the watershed development activities**.** To this end they also said that as there is no enough data on the watershed base, it is difficult to see the impact of the watershed based interventions**.**

5. **The watershed approach is expensive to implement or need more industrial inputs**

   The FGD and key informant interview participants of the treated and untreated areas pointed out that they have tried to do most of the activities on their own free will but the investment cost of most activities are unaffordable. To this end they raised concrete examples of big gully reclamation, water point development and rural road construction. Considering our level of poverty it is difficult to purchase industrial materials that can construct the above mentioned components. On the other hand they also believed that some areas are excluded because of the fact that watershed development is expensive and requires more industrial inputs.

6. The FGD participants in the treated area disclosed that watershed based natural resource conservation activities in some case has been implemented in a fragmented or disintegrated manner .This has resulted in technical failure in some of the SWC measures and area closers .Therefore due emphasis should be given to the principles of the watershed approach to this end treatments should start from upper catchments to lower catchments following the water flows.

CHAPTER- V: CONCLUSION AND RECOMMENDATIONS

5.1. Conclusions

In the process of ensuring food security and poverty alleviation the government of Ethiopia and donor agencies have been adopting different strategies to implement food security program. The watershed approach has been used as one of the main strategies to implement food security program in Tigray as a general and the study woreda in particular. Despite the fact that huge investments are made on the watershed basis impact of those programs are rarely studied. With regard to the Mai zeg zeg watershed management program in Degaua Tembein Woreda the impact and contribution of the program to the food security of the targeted households was not adequately studied.

This study has attempted to focus on the impacts of integrated watershed management program on food security by taking three program components, household income, environment, and potable water.

The result indicted that households in the treated areas are with better income than household in the untreated areas. The matching results showed that the program participants have enjoyed an average gain in the total household income between ETB 566.170 and ETB 340.098. The households in the treated areas have better income because they had better opportunity to diversify better and more income sources and they also had significant income from crop sales which resulted from increased production and productivity. As a main contributing factor to the food security level of the households when we see the gain in land productivity, the results showed that the program participants have benefited with production gain in total production per tsimidi between 2.418 and 0.65 quintals. This has happened due to the increase in the land productivity which was resulted from intensive soil and water conservation measures which were constructed by the watershed management food security program on cultivable land and accompanied with moisture holding in past five years. Other important factor that has contributed to the increased total production is that

the households in treated areas are practicing the use of selected seed variety. To this end the finding of the study showed that the program participants have benefited with an average production gain in selected wheat variety production per tsimidi between 1.090 and 1.211 quintals.

On the other hand the result on cost of fertilizer usage of households indicates that the program participants have better purchasing power of fertilizers. The result shows that the participants are spending Birr 106.730 and Birr 63.726 on fertilizer.

With regard to the number of months a household can feed his/her family from own production the analysis results has showed that the program participants have a gain of feeding their family for more months from own production. The participants have gained a benefit of feeding their families for extra more months of 0.600 and 1.620.

The study finding on the average livestock holding showed that the program participants have not made any significant gain due to their livestock holding. Moreover the study showed that the non-participants have gained 0.353 and .938 TLU in the livestock holding.

The second most important issue that this study tried to assess is that the impact of the program on the environment. The study findings showed that there are two major benefits gained from the natural resources management which are increased vegetable coverage and increased water discharge in down streams of the constructed SWC measures. In terms of percentage 96% of the program participants responded that vegetation coverage and water discharge in down streams of the constructed SWC measures increased and the 4% do not know anything about the change .

The FGD participants in the treated area support the idea that in their locality due to the integrated watershed management program there is increased vegetation coverage. According to the participants the increased vegetation coverage was facilitated due to the area closure practice. Due to the increased vegetation cover animal fodder increased and bee keeping activities expanded. Similarly the FGD participants in the same area responded that due to the intensive SWC works and gully reclamation supported by

skilled laborers and gabion mesh wires there is a remarkable change in protecting arable land which resulted in moisture holding and increased water discharge in down streams of the constructed structures . According to the discussion participants 2/3 of the arable and 3/4 public land was conserved and this caused increased land productivity per ha in the treated areas.

Finally the study has assessed the impact of the program on water coverage and related indicators. The study results on water access indicated that the project participants have much better access than the non participants. To this end 93% of the project participants have responded that they have access to clean water source but none of the no participants have responded that they have access to clean water source. On the other hand 7% of the project participants have not access to clean water source and 99% or almost all of the non participants do not have access to clean water sources.

On the other hand the estimated results on average time to fetch water and average number of liters a household consumes per day showed that the non- participants need more time to reach the water point and fetch water. The non participants need an average extra time between105.024 and 119.277 minutes. This has happened due to the limited intervention to develop water points in the untreated areas. On the other side the program participants have more access to water points and gained a significant benefit of average walking time to reached the water point. Because the participants have to walk 67.9125 minutes to reach the water point and fetch water. But the result showed that the program participants have not made any significant gain on water utilization. On figurative terms they made average consumption between 2.171 and 4.353 liters per/day. These results show quite low gain or insignificant gain. This further implies that the program participant have easy access to water points but low awareness on water utilization.

5.2 Recommendations

Based on the findings of this study, the following recommendations were sought for better success of the watershed based food security programs in improving the livelihoods of the community which it targets.

1. The fact that there is wide spread poverty elsewhere in the country as a general and the Tigray region in particular and it is inevitable that there must be interventions focusing on poverty alleviations, to this point, the study findings show that the intervention on watershed bases can bring significant changes on the lives of the poor . The sustainability of those positive impacts has paramount importance than overall implementation of such programs. Therefore in order to make all interventions of the watershed programs sustainable the concepts and principles of the watershed approaches should be participatory and institutionalized at all local levels.
2. The study finding showed that in the treated area the SWC measures constructed on the private and communal land have resulted in increased land productivity. More over these structures induced increased water discharge. Due to this fact irrigation practices was started and water was available even for other uses. On the other hand the study findings showed us the continuity of these benefits is not sustainable. This was due to the ownership problem of the beneficiaries which lead them to the problem of dependency syndrome. Therefore we strongly recommend that the role of such programs in construction of such structures on private land should be facilitation and the beneficiaries should do the activities by themselves, so that the sense of ownership could be maintained.

3. The study results have shown that the area closures can bring remarkable impacts towards achieving the desired environmental impact. Moreover it can facilitate the concept of zero grazing which has a significant role in the

regeneration of the vegetable coverage that can contribute to the environmental wellbeing. Again the sustainability of the component is not clear. To this regard in order to have sustainable area closures first area closures should be established based on good will and full participation of the targeted community. Second the economic benefits out of area closures should be clear and maintained to the beneficiaries. Thirdly the study result implies the integrating bee keeping activities in side area closures has more sustainable futures and this should be encouraged so that area closures should give multiple benefits to the targeted community.

4. The study finding showed the water coverage in the treated area is encouraging but the sustainability to this regard is still very weak therefore we recommend that the reestablishment of the water user committee and giving refresher training is important. We also recommend creating very clear and defined linkage of the committee with woreda water office is quite important.

5. The study finding of the integrated watershed food security program in Mai zeg zeg has shown remarkable achievement in improving the food security of the targeted households. Therefore we recommend to scale up of the program to other untreated area.
6. Regardless the paramount benefits, the study findings showed that there are different problems associated with integrated watershed management approach but the study has limitations to address what kind of institutional set up are more convenient in implementing the watershed approach. Therefore we recommend that further researches should be conducted in this regards.

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Appendices

Appendix I: Figures

Figure9. *During treatment*

Figure *10.After treatment*

Source: Project documentation.

Figure 11.Zenako irrigation site where SWC measures showed an impact

Source: photo taken during field observation, 2009.

***Figure12**. Area closures as source of grass cut and carry*

Source: Photo taken during field data collection, 2009

***Figure13**. The grasses cut and carry system in practice*

Source: photo taken during field observation and data collection, 2009

Figure14. Bee keeping practices in Area closures

Source: photo taken during field data collection

Appendix II. Tables of Estimated Results

Probit Estimation of the propensity score

Cont.vaiab	Coef.	Std. Err.	z	P>z
hhage	.0938844	.0639637	1.47	0.142
agesq	-.0006638	.0006499	-1.02	0.307
hhlit	.3060871	.2337716	1.31	0.190
TLhol	-.473648	.079483 ***	-5.96	0.000
tfsize	.2233043	.062118***	3.59	0.000
comem	.013686	.2477839	0.06	0.956
_cons	-2.553438	1.418443*	-1.80	0.072

Number of obs	=	197
LR chi2(6)	=	56.16
Prob > chi2	=	0.0000
Pseudo R2	=	0.205

Appendix III: Household Survey Questionnaire

MEKELLE UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANGEMENT

MA DEGREE IN DEVLOPMENT STUDIES

IMPACT OF WATERSHED MANAGEMENT PROGRAM

ON

FOOD SECURITY

HOUSEHOLD SURVEY QUESTIONNAIRE

Region _____

Zone: _____

Wereda: _____

Tabia: _____

Kushet: _____

Household ID: _____

Respondent's name: _____

Date of the interview: _____

Enumerator (Name and Signature):_____

Questionnaire Code: _____

December, 2009, Mekelle

I .GENERAL INFORMATION OF THE RESPONDENT

S.N	Question	Possible response	
1.1	Name of the interviewee:	_____	
1.2	Sex of the interviewee (**circle one**)	1. Male	2. Female
1.3	Age of the interviewee	_____years	
1.4	Are you (interviewee) the Head of the Household? (**circle one**)	1.Yes	2.No
1.5	Can you read/write? (**circle one**)	1.Yes	2.No
1.6	If your answer for number 1. 5 is 'Yes', where do you put yourself? (**circle one**)	1.Traditional Education (e.g., nay keshi timhirti)	
		2. Elementary incomplete	
		3. Elementary complete	
		4. Secondary incomplete	
		5. Secondary complete	
		6. Above secondary	

1.7. **Basic Household Characteristics**

This is a list of all members of the household (exclude the house hold head)

S.No	Name of Family Member	Type of Membership	Sex Male =1 Female =2	Age (in Years)	Level of Education	Marital Status	Religion	Occupation	Skill
1									
2									
3									

4									
5									
6									
7									
8									

S.N	**Questions**	**Possible responses**	
1.8	Are you or any HH member a committee member? (**circle one)**	1.Yes	2.No➔2.1
1.9	If Yes to Q 1.8, how often does the committee meet?	1.Meets every week 2.Meets frequently (monthly at least) 3.Meets occasionally (3-4 times a year) 4.Meets rarely	
1.10	How you feel the community committee(s) that you participate in satisfying users need?	1. Functions well 2. Functions better 3. Functions poorly	

II. Wealth, Income, Land holding and Land productivity

S.N	**Questions**	**Possible responses**
2.1	Do you own or rent land for agricultural use in the last 12 months? (**circle one**)	1. Yes 2. No
2.2	How did you use the farm land during the last 12 months?	1. Used for own crop production 2. Rented it out 3. Remained idle (fallow) 100.Others(specify)_____

2.3**.** If Q 2.1 is yes, what is the size of land under different use during the last 12 months in tsimdi?

Code	**Land type**	**Area in tsimdi**

1	Total land owned	
2	Crop land, Rain fed	
3	Cropland, Irrigated	
4	Pasture area	
5	Forest/trees	
6	Homestead	
100	Others (e.g. wasteland)	

2.4	If you rented land in the past 12 months, which type of land and the rent per tsimdi?	Code	Land type	Size of land rented (tsimdi)	Rental (Birr)	
		1	Rain fed			
		2	Irrigated land			
		3	Pastureland			
2.5	Which type of selected variety of crops did you introduced in last 3or 4 years, and are you now planting these improved seed on a regular basis? (circle on the crop variety)	1. Sorghum 2. Chickpea 3.Teff 4. finger millet 5. Sesame 6. pulses 7. Ground nut 8. Pigeon pea 9.wheat 10. Maize 11. Barely 12.Hanfets 100. others(specify)				
2.6	Have you noticed an increase in production from these new varieties of crops?(**circle one**)	1.Yes 2.No➔				Q2.12
2.7	If Q 2.6 is yes, on which varieties of crops did you noticed the increased production?			1.Yes	2.No	
		1. Sorghum				
		2. Chickpea				
		3.Teff				

		4. finger millet		
		5. Sesame		
		6. pulses		
		7. Ground nut		
		8. Pigeon pea		
		9.wheat		
		10. Maize		
		11. Barely		
		12.Hanfets		
		100. others(specify)		
2.8	If Q2.6 is yes, what do you think is /are the 3 main reasons for the increase in crop production?	1.Improved soil fertility		
		2.Better efforts(labor productivity)		
		3.Improved cultivation Practices		
		4.Better availability of rain water		
		5.Better water harvesting as a result of SWC		
		100. Others specify		
2.9	If Q 2.6 is Yes, did the increase in the production of these selected varieties improve the availability of food or income for your households?		1.Yes	2.No

2.10	If Q2.9 is Yes, what is the quantity produced for different varieties in the last 12 months?		Area Planted, (Tsimidi)	Production, in (kg) per tsimidi)	Current market price per kg
		1. Sorghum			
		2. Chickpea			
		3.Teff			
		4. finger millet			
		5. Sesame			
		6. pulses			
		7. Ground nut			

		8. Pigeon pea			
		9.wheat			
		10. Maize			
		11. Barely			
		12.Hanfets			
		100.others(specify			
2.11	If Q 2.9 is No why? (multiple answer is allowed)	1. The increase in production is not proportional to my family size 2. The increase in production is not proportional to the family labor devoted 3. Even though I produced more, the price fluctuation reduced the income from the sale of these crops 4. The income I get, does not much with expense (the cost of other commodities that are need for the HH is higher than my income from the sales of these produces) 100. Other specify _____			
2.12	Did you or your family member know any technique/ methods of crop production?		.1 Yes	2. No	
2.13	If Q 2.12 is yes, Which technique/s are you using now? (Multiple answer is possible)	1. Integrated pest management (IPM) 2. Row planting 3. Inter/mixed cropping 4. Crop rotation 5. Seed preparation/selection 6. Soil preparation		7. Vegetable production 8. Post harvest management 9. Fertilizer applications 10. Composting 11. Green manuring 12. Irrigation 100. other, specify	

2.14. Crop produced during the past 12 months and sales (Rain Fed)

Sr. No.	Type of crop produced	Area (tsimdi)	Amount of seed used (kg)	Cost of seed or seedlings (Birr)	Day of worked per year	Production (qt)	Amount sold (qt)	Income from sales (Birr)
1	Sorghum							
2	Groundnuts							
3	Teff							

4	Finger millet							
5	Wheat							
6	Maize							
7	Hanfets							
8	Barely							
9	Flax							
10	Vetch							
11	Pigeon pea							
12	Peas							
13	Horse beans							
14	Lettuce							
15	Potato							
16	Swiss chard							
17	Beef root							
18	Spices							
19	Chick peas							
20	Lentils							
21	Field pea							
22	Onion							
23	Pepper							
24	Tomato							
25	Cabbage							
26	Carrot							
100	Others Specify							

2.15. Amount and cost of fertilizer and chemicals used for the crop specified in Q2.14

Sr. No.	Type of crop to which fertilizer applied	Urea (kg)	DAP (kg)	Cost of fertilizer (Birr)	Manure (kasha?)	Compost (kasha?)	Cost of chemicals applied (Birr)
1							
2							
3							
4							
5							

2.16	Did you use irrigation to grow crops during the past 12 months?	1. Yes 2. No➔	Q 2.28

2.17. What is the source of water for the irrigation?

S.No	**Source of irrigation water**	**Possible response (tick)**
1	River with traditional canal	
2	River diverted with lined canal	
3	Pond or horeye	

4	Spring/wells using traditional means	
5	Spring/wells developed with pumps	
100	Others (specify)_____	

2.18. What type of crop produced during the past 12 months and sales income (with irrigation?)

Sr. No.	Type of crop produced	Area (Tsimdi)	Amount of seed used (kg)	Cost of seed or seedlings (Birr)	Production (qt)	Frequency of production per year	Amount sold (qt)	Income from sales (Birr)
1	Groundnuts							
2	Barley							
3	Pigeon pea							
4	Onion							
5	Pepper							
6	Tomato							
7	Cabbage							
8	Carrot							
9	Papaya							
10	Mango							
11	Orange							
12	Banana							
13	Teff							
14	Maize							
15	Wheat							
16	Hanfets							
17	Guava							
18	Potato							
19	Lettuce							
20	Swiss chard							
21	Spices							
22	Beef root							
100	Others Specify							

2.19. Amount and cost of fertilizer and chemicals used for the crop specified in Q2.18

Sr. No.	Type of crop to which fertilizer applied	Urea (kg)	DAP (kg)	Cost of fertilizer (Birr)	Manure (kasha?)	Compost (kasha?)	Cost of chemicals applied (Birr)
1							
2							
3							
4							

5							
6							

2.20	Do you own or pay rent for using the land that is irrigated in the past 12 moths	1. own the plot 2. rent the plot	
2.21	If you rent the irrigated land, how much do you pay for the land you rented?	_____Birr _____ % of crop _____ other payment	
2.22	Have there been any changes in the availability of irrigation water to you since you use irrigation.	1. Increase in water 2. Decrease 3. no change	Q 2.24
2.23	If Q 2.22 is Decreased, What was the cause for the water shortage?	1. Damage of irrigation water canals 2. Leakage of irrigation water canals 3. Lack of maintenance of water point 4. Lack of equitable distribution of water 5. Shortage of water due to upstream water shortage 6.shortage of rain fall 100. Other, specify _____	
2.24	Is there today an active committee or group in the community that is responsible for maintenance and management of the irrigation water system (the water sources, canals, etc…)?	1. Yes 2. No➔	Q 2.27
2.25	If Q 2.24 Yes, in your opinion do you think this committee has been efficient in managing the irrigation system? (Rate their performance)	1. Excellent 2. Very good 3. Fair 4. Poor 5.Very poor	
2.26	If Q 2.25 Poor or very poor, why?	1. Don't meet often enough 2. Not enough input from water users 100. others specify _____	
2.27	During recent droughts, and since the irrigation system was established, was irrigation water still available in sufficient quantity to irrigate crops in a normal way.	1. Yes 2. No	
2.28	Have the number of the different types of crops you have been growing changed over the last 5 years?	1. Yes 2. No➔	Q 2.30
2.29	If Q 2.28 is Yes, how?	1. The no. of different types of crops grown increased 2. The no. of different types of crops grown decreased	

2.30	What are the number of months you could feed your family from own production and other sources?		Own production	Other sources	
		Number of month			
2.31	If you or your family participated in the Safety Net Program (PSNP), how many months does the food/cash provided covers the household food need?		_____ months		
2.32	If the food available decreased, what could be the reasons? (multiple answer is allowed)		1. Low production due drought 2. Low production due to poor soil 3. Larger family size 96. Other (specify)		
2.33	When there is food gap (shortage), how do you meet the food demand of your household/family? (State the options in the order of importance)	1. Borrow money/food 2. Sell livestock 3. Rent out land 4. Sell household furniture 5. Sell jewelries 6. Sell firewood/ charcoal 7. Involve in petty trade 8. Involved in wage work 9. Migrate to town 10. Reduced meal size 100. Others (specify)____			
2.34	Did you have oxen for plowing?	1.Yes ➔ 2. No			Q 2.36
2.35	If Q 2.34 is No now, why? (multiple answer is allowed)	1.I have sold it 2.My land doesn't need oxen 3. I don't know how to do it	4. I have no land 5. The oxen died 100.Other (specify)		
2.36	What are the numbers of other livestock that you have now?	Number of livestock 1. Cows ____ Nos 4.Pack animals _____Nos 2. Sheep _____Nos 5. Bee colony _____Nos 3. Goats _____Nos. 100. Others specify _____			

2.37	If you have more animals now, how have you managed to obtain them?	1. Purchase with income earned from production 2. Payment of debt from someone

		3.From animal reproduction 100. Other (Specify) _____

2.38. Type of income generation activities and income earned during last 12 months

Sr. No	Type of income generation	Income/Profit (Birr)
1	Petty trade	
2	Household enterprise	
3	Handcraft	
4	Sales of firewood/charcoal	
5	Wage work other than PSNP	
6	PSNP	
7	Beekeeping and sale of Honey	
100	Others _____(specify)	

2.39. Animal products

Sr. No	Product Type	Quantity produced last month	Unit type(Code)	Purpose used	If sold, how much quantity sold
1.	Butter				
2.	Cheese				
3.	Yoghurt				
4.	Honey				
5.	Wool				
6.	Egg				
7.	Skin (Goat & Sheep)				
8.	Hide (cattle)				
96.	Others (Specify)				

Unit of measurement

1. Kilogram 2. Liter 3. Count (Number) 100. Others (specified)

III. Environnemental Impact (Natural Ressources Management)

3.1**.** What type of environmental changes do you observe in your localities?

S.no	Environmental change	Tick on the responses
1	**Soil erosion**	
2	**Deforrestation**	
3	**Expansion of marginal land**	
4	**Shortage of water**	
5	**Gully formation**	
100	**Others specify** _____	

3.2	Do you believe that there is land degradation problem in your area? (**circle one**)	1.Yes 2.No

3.3. If yes, what are the main factors of land degradation and the level of the problem?

Factors	1.Extremely dangerous	2.Dangerous	3.Minor problem	99.I do not know
1.Soil erosion				
2.Deforestation				
3.Overgrazing				
4.Over cultivation				
5.Lack of fallowing				
6.Crop pattern				
7.gully formation and expansion				
100. Others				

3.4. How do you see the rate of land degradation?

S.no	Change	Tick on the response
1	Increasing fast	
2	No change	
3	Decreasing	
99	No idea	

S/N	Questions	Possible responses	Skip
3.5	Did you or any member of your family participate in the watershed management activities?	1. Yes 2. No	
3.6	If yes, did you feel the management allowed enough participation of users in making decisions about land closure and other conservation measures used	1. Yes 2. No	
3.7	Would you have participated in the conservation measures and maintenance of existing structures if food or cash wasn't provided for your labor? i.e. Would you have volunteered your labor?	1. Yes 2. No	
3.8	Do you feel that the participation of the community in the decisions was important to the success of the process of environmental change?	1. Yes 2. No	
3.9	How do you benefited from watershed based conservation activities?	1. Cut and carry of grass 2. Provision of seedling 3. Wood from trees 4. Fruit from trees 5. Honey production 6. Improved environment 7. Improved micro-climate 8. Water availability improved 9. More crop production 100. Other, specify	
3.10	In your experience, which types of soil conservation measures are effective?	1. Soil bund	

		2. Stone Bund 3. Check dam construction 4. Enclosure 5. hill side Terracing 6. Tree planting 100. Other, specify	
3.11	Have you done any conservation measures since past five years?	1. Yes 2. No ➔	Q 3.14
3.12	If Q 3.11 is Yes, what type of soil and water conservation measures have you done on your private land?	1. Soil bund 5. Hill side Terracing 2. Stone bund 6. Tree planting 3. Check dam construction 100. Other, specify 4. Trench bund	
3.13	If Q 3.11 is Yes, what type of soil and water conservation measures have you done on communal land?	1. Soil bund 2. Stone Bund 3. Check dam construction 4. Trench bund 5. Hill side Terracing 6. Tree planting 100. Other, specify	
3.14	Have you planted tree seedlings in the past five years)?	1. Yes 2. No ➔	Q3.18
3.15	If Q3.14 is Yes how many planted and how many survived on your private land?	1. Total number of seedlings planted since last five years , _____ 2. Total number of seedlings currently survived _____	
3.16	If Q3.14 is Yes how many planted and how many survived on communal	1. Total number of seedlings planted since last five years , _____	

	land?	2. Total number of seedlings currently survived _____	
3.17	If Q3.14 is Yes, what were your sources of seedlings?	1. Own private nursery 2. Purchased from individual private nursery 3. Provided by government for free 4. Provided by an NGO for free. 5. Bought it from government 6. Bought it from an NGO 100. Other, specify	
3.18	Do you use grass cut and carry from the enclosed area?	1. Yes 2. No ➔	Q3.22
3.19	If Q3.18 is Yes, number of time per year you harvest the grass (cut and carry system	1. One time 2. Two times 3. Three times 4. More than three times	
3.20	If Q3.18 Yes, for what purpose do use the grass?	1. For own animals' feed 2. For sales 3. For house construction 100. Other specify	
3.21	If Q3.18 is for animals' feed, is it sufficient for feeding your animals?	1. Yes 2. No	
3.22	What are the problems If any with enclosure? (open ended)	1. _____ 2. _____ 3. _____	
3.23	What problems, if any, do you see with management of the soil and water conservation measures? (open ended)	1. _____ 2. _____ 3. _____	
3.24	What change did you observed since the natural resource management activities have been conducted in the past five years?	1.Vegetation coverage increased 2. Land productivity increased 3. Water discharge increased in the down steams of the SWC measures	

		4. There is no change	

3.25. What type of Natural resource conservation technique did you applied or currently applying on your private family land and communal land?

Line #	Type of Natural resource conservation technique (more than one answer is possible)	**Tick on the Possible response**	
		Private land	Communal land
1	Live/vegetative barriers		
2	Contour plowing		
3	Dry walls/stone barriers/soil bund/stone bund		
4	Terracing		
5	Tree planting		
6	Private tree nurseries		
7	Gully control		
8	Fallowing		
9	Bund construction		
10	Bund stabilization		
11	Cut-off drainage		
12	Grass strip		
13	Cover crops		
14	Area enclosure/mgmt		
15	Agro forestry		
100	Other specify		

3.26. HH income from natural resources conservation activities

Line	PRODUCT TYPE	Units type	No units produced per	Value per unit (Birr,)

#			year	
1	Cut poles from the tree			
2	Cut branches			
3	Fodder (leaves)			
4	Fuel wood			
5	Charcoal			
6	Grass (cut and carry)			
7	Honey production			
8	Fruit production			
100	Other (Specify)			

IV - Water Coverage and Related Indicators

S.N	Questions			Possible responses	Skip
4.1	Do you have access to clean and safe drinking water that used for domestic consumptions? (**tick on one**)			**1**.Yes 2.No	
4.2	What are the sources of drinking water for domestic consumption? (multiple answer is allowed)	**Code**	**Source of drinking water**	**Tick on the response**	
		1	River		
		2	Unprotected spring		
		3	Pond		
		4	Hand dug well (protected)		
		5	Protected spring		
		6	Deep well		

		7	Water Tap at house		
		8	Shallow well (drilled)		
		100	Other (specify)		
4.3	How much liters of water do you consume daily? _____liters				
4.4	Is more water (for different purposes) available all year round for your HH? (circle one)			1.Yes 2.No	
4.5	Are you a member of the water users association? (circle one)			1.Yes 2.No	
4.6	Do you feel the users have enough say in how the system is operated? (circle one)			1.Yes 2.No	

S.N	Question			Possible response	Skip
4.7	What is the source of water for livestock? (multiple answer is allowed)	Code	Source of water for animal	Tick on the response	
		1	River		
		2	Unprotected spring		
		3	Pond		
		4	Hand dug well (protected)		
		5	Protected spring		
		6	Deep well		
		7	Water tap at house		
		8	Shallow well (drilled)		
		100	Other (specify)		
4.8	Did you or any member of the household participated in the water supply scheme development?			1. Yes 2. No ➔	Q 4.10
4.9	If Q4.8 is Yes, how did you or your household member	1. Free labor contribution		6. Wage worker for construction	

	participate? (multiple answer is allowed)	2. Local construction material supply 3. Coordination or facilitation 4. Water committee 5. Guard 7. Cash 8. Site selection 9.land provision without compensation 100. Others (specify	

4.10	How much time does it take to fetch water round trip not including waiting time?	Seasons	Time (in minutes or hour)	
		1. Dry season		
		2. Wet season		

4.11	How long do you queue/wait / to fetch water?	Seasons	Time (in minutes or hours)	
		1. Dry season		
		2. Wet season		

4.12	Total amount of water collected by the household per day? (Ask no. of trips per day and the no. of Jerrican or other container used to fetch water, make sure to ask the size of the container)	Season	Total amount of water collected per day	
		Dry season		
		Wet season		

4.13	How do you treat drinking water before use?	Code	Drinking water treatment	Tick on the response	
		1	Add Wuha Agar		
		2	Boiling		
		3	Filtering with sand or cloth		
		4	Sedimentation by		

			its own		
		5	No treatment		
		100	Others (specify)		
4.14	If Q4.13 is NO TREATMENT now, why? *(Do not read the answer. One or more answer is possible)*	1. No need, the water is pure 2. Would like to treat, but do not know how to treat the water 3. Shortage of time 4. Use of water as fetched is a tradition 100. Others (specify)			
4.15	Is the water supply in your area fairly distributed to households?	1. Yes 2. No			
4.16	Was /is there any conflict between households or community on the water use?	1. Yes 2. No ➔			Q 4.18
4.17	If Q 4.16 is Yes, what do you think is the cause of the conflict?	1. Water shortage 2. Insufficient cattle trough 3. Unfair water distribution (not available to all HHs) 100. Others (specify)			
4.18	Who is responsible to repair the water supply points if damaged?	1. Staff of the water resources office (government) 2. NGO 3. Trained community member 4. Technicians 100. Others (specify)			
4.19	Do you pay a fee or contribution for use of the water?	1. Yes 2. No ➔			Q 4.21
4.20	If Q 2.19 is No, what is the reason?	1. It is expensive 2. I do not have money			

		3. I can fetch water freely, no need to pay 100. Others, specify _____	
4.21	Are you satisfied with the management of the water point by the water Committee?	1. Yes 2. No	
4.22	Did you or your household member get any benefit from the current water supply?	1.Yes 2.No	
4.23	If Q4.22 is yes, What are the major benefits obtained to you or your household members from the water supply?	1. Time savings 2. Improve income 3. Health improvement 4. More water for other uses 96. Others, specify _____	
4.24	If your response for Q4.23 is health improvement how do you see the incidence of water born disease?	1. It is significantly reduced 2. It is moderately decreased 3. It is not decreased 100. others, specify_____	
4.25	If your response for Q4.23 is Time saving, how do you or your family members use the extra time saved in collecting water from the new sources?	1. Schooling 2. Other work to earn income 3. Care for children 4. Socializing 5. Rest 100. Others specify	
4.26	Do your livestock have access to your water points	1. Yes 2. No ➔	Q 4.29
4.27	If Q4.26 is Yes, has this access to the water point resulted in improved health and productivity of the livestock	1. Yes 2. No 3. No change	Q 4.29
4.28	If Q4.27 is Yes, is less time spent providing water for your livestock?	1. Yes 2. No	

		3. No change	
4.29	Compared to past 5 years, how do you evaluate the water quality now?	1. Good 2. Poor 3. No Change	
4.30	What are the outstanding problems of water supply in your area now? (Rank)	1. No problem 2. Shortage in quantity 3. Poor water quality 4. Operation of the constructed water source is faulty 5. Management of water point 6. Maintenance of the water point 100. Others , specify _____	
4.31	During the drought season, did you suffer from a lack of household water or water for your livestock?	1. Yes 2. No	

Qualitative Data Collection Tools discussion point for FGD

I. **Wealth, Income**, **Land holding and Land productivity**

1. How do you evaluate your land productivity without the project and with the project?
2. Did the conservation measures on your land accompanied with moisture holding and then better productivity? Do you use improved seeds for better productivity?
3. In your area did the project participants own wealth or increases income because of their participation in watershed management project? If yes how explain by more discussion?

II. **Environnemental Impact (Natural Ressources Management**)

1. How do see the Environmental change over the last five years?
2. What change did the watershed management project made to your area?
3. Are there more conservation measures done by the project on communal and private land?
4. What proportion of communal land that need treatment has been covered with protection measure since the past five years? If not all, why not? Who is

responsible to maintain the constructed natural resource conservation measures, especially the one which was constructed in the communal land? Did the communities have undertaken any maintenance work in natural conservation structures so far?

5. How do you manage the communal land or enclosure in your area? What are the mechanisms to share the benefits from the conserved communal land among the communities? In your opinion do you think the benefit sharing system is providing equitable benefits? If yes how? If not why?
6. What impact do you observed after the construction of soil and water conservation measures?
7. Is there any benefit that is gained from the natural resource conservation to the community?
8. Are there additional direct or indirect benefits to the households in the community, apart from cash or food income from wage payment, derived from the natural resource conservation activities? Probe the group to explain in terms of house hold income and overall household benefit including other benefits such as grass cut- carry ground water recharge, wildlife, microclimate improvement, etc....
9. In your opinion, do the NRM activities of the project contribute to the food security in the watershed? if yes ,how ?if no ,why?
10. Do you or anybody in your localities built assets (at household level) due to the involvement of natural resource conservation activities or the benefit obtained from the conserved areas?
11. Would you please tell us the any improvement in the lives of your community and households (in terms of increase income, increase productivity) due to the natural resource conservation measures compared with the previous years? If there any benefits do you think these benefits will continue in the future? Why? How?
12. Are there any unintended negative impacts of the watershed interventions?

III. **Water Coverage and Related Indicators**

1. Did the project improve water supply in the area?
2. Explain how your activities of your daily life have changed since having the new water points? What is different from before the community had the new water points?
3. Explain all of the uses being made of the water? Are there different uses being made for water points? Explain how?

4. How is the water borne disease before and after the project?

5. How do the constructed water points function? Fee system? Maintenance? Can the community manage the water supply without help from the government or other? Explain how?

6. Is there now more extra time which was used in water collection? And how use it?

7. How has the water system affected women and girls in particular?

IV. **Problems Associated with Watershed Management Approach and Possible Solutions**

5.1. What type of problems did you observe in the water shed management approach?

Code	Possible Problems for Discussion	Tick on confirmed points
1	It excludes administrative boundaries	
2	It lacks data on given watershed base	
3	It is not yet institutionalized	
4	It is difficult to monitor	
5	It is expensive (needs industrial inputs)	

5.2. On your opinion, what are the possible solutions to the problems associated to the watershed management approach**? (It *is open-ended question*)**

1. _____

2. _____

3._____

4._____

5._____

Do not forget to thank the respondent before you leave!!!