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[SUSTAINABILITY OF TIBIDP]

**SUSTAINABILITY OF TIBILA IRRIGATION BASED INTEGRATED
DEVELOPMENT PROJECT.**

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**A thesis submitted to the school of Graduate Studies, College of
Developmental studies, Center of Environmental studies; Department of
Water and Development.**

**Presented in partial fulfillment of the requirements' for the Degree of
Master of Arts.**

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Abstract

Sustainability of Tibila Irrigation Based Integrated Development Project

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Addis Ababa University, 2012.

This study analyzed the sustainability of Tibila irrigation based integrated development project located in Arsi Zone of Oromia region, Ethiopia. Results are based on primary and secondary data collected from a sample survey of 110 households, focus groups discussion and key informant interviews as well as secondary document analysis. Analysis in descriptive statistical methods using SPSS, IBM is used and analysis of qualitative information supplemented the result. The project was analyzed against socio-economic, technical and environmental sustainability's. The scheme is a new large scale irrigation based development project under implementation and development. It was planned to cover about 7000ha of land when totally completed and will support a population more than 16000. Currently about 2000 farmers are using 1200ha of land to produce with. The results of the study revealed that within the three year time, the farmers were producing 3-6 rounds and it is found that farm households have started to grow crops which were not previously grown in the areas such as passion fruits. It was also found that it has a positive impact on their income, on employment improvement as well as on the living standard of their families. In addition, through time beneficiary farm households depend more on the production from their irrigated fields, which enabled them to harvest more than once a year. Therefore, as beneficiary farmers shift to high value but perishable commodities, emphasis should be given to marketing extension, especially in facilitating markets and market linkages to farmers. Furthermore, through time the demand for irrigation water increases among beneficiary farmers. As a result, scarcity of water especially during the peak period is experienced. Some conflicts on water use and distribution are also experienced among the beneficiaries due to certain technical faults, management challenges and some inefficiency's. Even though Environmental challenges such as salinity, logging and erosion are at their initial stage, emphasis should be given to water shed management and improved farming land and irrigation water management practices. Water User Association or organization and farmers have to be strengthened and empowered in depth in technical, i.e. water management, farming technologies, institutional and scheme administrations and in environmental issues to use the scheme on sustainable basis while keeping the socio-economic and ecological balances in the basin.

[Key words: - Sustainability, Water management, socio-economic and ecological balance]

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Acronyms

AAU-	Addis Ababa University
BMC-	Billion Meter Cube
CBIWM -	Community Based Irrigation Water Management
FAO-	Food and Agriculture Organization
FGD -	Focus Group Discussion
IWM-	Irrigation Water Management
IWMI-	International Water Management Institute
Ha-	Hectare
LSIP-	Large Scale Irrigation Project
MER-	Main Ethiopian Rift
MOWR-	Ministry of Water Resources
NGO-	Non Governmental Organization
O&M-	Operation and Maintenance
OWMEB -	Oromia Water Mine and Energy Bureau
OWWCE-	Oromia Water Works Construction Enterprise
OWWDSE-	Oromia Water Works Design and Supervision Enterprise
SNNPR-	Southern Nation Nationalities and Peoples Region
SPSS-	Statistical soft ware for social sciences
TIBIDP -	Tibila Irrigation Based Integrated Development Project
TISMU-	Tibila Irrigation Scheme Management Unit
TPP-	Total Physical Product
UNESCO -	United Nation Economic, Scientific and Cultural Organization
WUA-	Water User Association
WUC-	Water User Committee

1. Introduction

1.1 Back Ground

Irrigation systems are important tools of meeting the increasing demand for food, and to the development, sustainability and productivity of the agricultural sector. In Ethiopia, with food production already lagging behind population growth, inefficient allocation of water for agriculture may worsen the problem of current food insecurity despite the available large volume of water in the country. Though, it is widely accepted that the overall performance of irrigation and drainage investments has often fallen short of the expectations of planners, governments and financing institutions (FAO, 1996), it has made a major contribution to the food production and food security throughout the world. Without irrigation, much of the impressive growth in agricultural productivity over the last 50 years could not be achieved. In 2000, Out of the world's total farmed area, 1.5 billion hectares (ha), about 18 percent was irrigated. For developing countries as a whole, the irrigated area has almost doubled over the last 40 years to cover 234 million ha in 2000 though Very little irrigation development has occurred in Sub-Saharan Africa (World Bank, 2006). Agricultural production in Ethiopia is largely rain-fed, which increasingly depends up on erratic and often insufficient rainfall. To cope both with an average of 3% annual population growth and the limitation of rain fed agricultural productivity, irrigation development is needed for food security and alleviating rural poverty. The need to increase agricultural productivity and attain food security is nowhere more pressing than in Ethiopia (Ersado, 2005). Ethiopia's total land area is estimated at 1.13Million km²; about 66 % is considered as arable land. Out of this total arable land 22.8% is already cultivated (UNESCO, 2006). According to MOWR (2002). 471,862 ha of land out of which 225,763 ha is small scale and 246,099 ha is large scale was planned to develop in short, medium, and long term from 2002 – 2016. There is a high spatial variability in water resources endowment and development in the country. Hence, 90% of the country's water resources development occurred in four river basins (World Bank 2006). Much of the formal irrigation developments are located in the Awash Basin, where about 50 medium- and large-scale irrigated farms are located. In terms of regional distribution, Afar and Oromia have the bulk of the share in irrigated agriculture accounting for 45 and 31%, respectively, of the total irrigated area. Amahara, Southern Nations,

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Nationalities and People's Region (SNNPR) and Tigray account for 8, 7 and 5%, respectively, of the total irrigated area (Selesh Bekele, et al, 2007).

As cited by Yohannes (2010), when the aggressive development plan and implementation of irrigation in the country compared to the experience the country acquired in the past is observed, question in sustainability, relevance, efficiency, effectiveness, environment and social concern ignites. Irrigation affects the material and the cultural life of society and the environment in four main ways: economic, social, environmental, and cultural. The impacts on each area varies with the type of irrigation system, and the magnitude (positive or negative) is subjective, but there is value in highlighting the complex and diverse roles of irrigation (Jean-Marc F, 2007). Five principal reasons to invest in irrigation are; first is to preserve and modernize the present stock of irrigation infrastructure. Continuing investment will be required to preserve the safety and improve the functionality of existing irrigation (Bakker, 1999). Second, irrigation can be a path out of poverty for the rural poor. Where pockets of rural poverty exist within an irrigated agricultural context, intensification and shifts to higher value crops will create new employment opportunities, as will value-added post-harvest processing and water-dependent off-farm rural employment in handicrafts, livestock raising, and similar activities (Bakker, et al 1999). Third is to adapt to changing food preferences and changing social priorities. Most of the increased production of staple crops in the coming decades will come from intensification in existing irrigated areas, with higher yields per unit of water and land and higher cropping intensities. Fourth, it improves water productivity, rapidly expanding urban populations and industrialization increase demand for both surface water and ground-water uses (Molle and Berkoff, 2006). Changing social values that emphasize natural ecosystem protection will increase water allocations to the environment. Fifth, investment will probably be needed to respond to climate change.

Given these importance of irrigation for the world's food supply and the vast resources expended on irrigation development, the actual performance of irrigation systems has been so disappointingly low. This is largely due to faulty design and construction, poorly-managed operations and inadequate maintenance (IWMI, 1991). Eduardo, 2009 states that in order to increase agriculture sustainability, an important aspect that has been considered by several researchers and studies are to design efficient irrigation systems at farm level. Irrigation system design substantially affects application efficiency and involves numerous variables

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and restrictions, whose principal objective is to maximize benefits and minimize costs. In a successful irrigation system, a set of resources produces maximum returns. To achieve this, optimization process supporting the design and operation of water application systems in agriculture is required due to many possible combinations of design variables that satisfy irrigation conditions. Irrigation systems have specific applications that are based in several factors, among which the most relevant are the crop, soil type, topography, and water availability and quality. The application efficiency of the different surface and pressurized irrigation methods varies and depends on design, management, and operation. Undoubtedly, well-designed and correctly used irrigation systems will have the highest efficiency and water distribution levels, which can result in a good production and high product quality.

Sustainability implies a condition in which the frequency and severity of threats to society are decreasing over time. It implies a condition in which our environment and ecosystems are being managed in a way that prepares people to cope with stresses when they occur. Variability in water flow and quality is a natural phenomenon and must be preserved if such systems are to sustain their natural, or near natural, ecosystems. However, very extreme events typically bring substantial economic damages. Thus, the prevention, management, and control of very extreme events have a high priority in the achievement of sustainability (Daniel P, 2000). Sustainability in irrigation water management can be indicated by; water supply system reliability, reversibility, and vulnerability, environmental system integrity, equity in water sharing, and economic acceptability (Ximing, 2001). Besides food self-sufficiency, achieving net profit over the long term is the motivating factor that sustains irrigated agriculture. Economically acceptable irrigation systems provide lifestyle and social options for farmers and also contribute to the wider economy and community. From the perspective of using water more economically, the great challenge in irrigated agriculture is to include the opportunity costs of irrigation water supply, which are often an order of magnitude higher than current charges. Another challenge is to include the long-term economic damage to the environment due to irrigation (Ximing, 2001). This study mainly focuses on sustainability analysis of Tibila Irrigation based integrated development project which is located in Oromia region of Ethiopia. It is a large complex scheme with various social, economic and environmental consequences if not managed well in sustainable ways.

1.2. Statement of the Problem

Irrigation has contributed significantly to poverty reduction, food security, and improving the quality of life for rural populations. However, the sustainability of irrigated agriculture is being questioned, both economically and environmentally. Tibila irrigation based integrated development project is a large scale irrigation project primarily designed to alleviate the chronic food in security of the area via efficient and effective uses of irrigation water. The water source for the area is the Awash River which is Trans-regional and one of the intensively used river basin. The area is characterized by dry climatic condition, high population density, and relatively dry watershed characteristics. The project is managed by the governmental enterprises and the farmers. The enterprise was given the mandate to operate and maintain the main system while the on farm water and system management were given to the beneficiaries. There are water loses and in efficient uses at different levels and locations in the scheme. Since it is a large scale irrigation project operated by farmers themselves with an advice from government agent, its management; irrigation system management, institutional and water management are not giving the intended service i.e. water allocation, distribution, use, system operation and maintenance, coordination and its institutional set up are also challenges for the farmers within themselves and with the up and downstream users and this puts the sustainability of the project under question. The sustainability of irrigation projects depends on the maintenance of the implemented schemes and mitigation measures taken. Negative environmental impacts of irrigation development occur off-site as well as on site. Sometimes full utilization of the water creates water shortage to downstream affecting ecosystem negatively. There is a need for research to understand the complex issues of water and land management, so as to enhance national and local capacity to deal with water and land management issues to enhance food security, reduce poverty and speed up national economic development. Hence this research will assess the sustainability of Tibila irrigation based integrated development project against socio- economic, technical and environmental sustainability's.

1.3. Objectives of the study

1.3.1. General Objective

The main objective is to Study the Sustainability of Tibila Irrigation Based Integrated Development Project.

1.3.2. Specific Objectives

The specific objectives are:-

- A. To analyze the technical functioning or water management practices of the project.
- B. To examine its Environmental Sustainability.
- C. To explore its socioeconomic Sustainability.

1.4. Major Research Questions

1. What are the impacts and effects of the new Tibila irrigation system: -
 - On sustainable use of the irrigation water in the locality?
 - On soil and water conservation practices (loss minimization)?
 - On socio-economic and livelihood improvement?
 - On production improvement?
 - On the environment?
 - On Employment opportunities?
2. How is water management practice taking place in the Tibila irrigation system?
3. How is community organized and its institutional arrangement looks like?
4. What are the major challenges for sustainability and management of the selected irrigation systems?

1.5. Significance of the Study

This study primarily focused on analysis of sustainability of Tibila irrigation based development project and its water management practices, to identify the challenges within it that could help device optimal management systems that can bring scheme sustainability so as to come up with food self sufficiency and economic enhancement in the area while keeping the environment safe. The results of the study are also expected to be useful for practitioners, governments, NGO's and policy makers in the development of best management options for large scale irrigation schemes Sustainability's in the country.

1.6 Scope and Limitation

The study assesses Tibila irrigation based development project, sustainability analysis and its irrigation water management practices. Due to Resource and Time constraint, Sample sizes were limited to 110 house hold members and variables considered were also some socio-economic, environmental and water management components like system management, water use efficiencies or effectiveness and certain organizational and institutional set ups' analysis of the scheme.

2. Literature reviews

2.1. Sustainability of irrigation

Sustainable water resource systems are those designed and managed to fully contribute to the objectives of society, now and in the future, while maintaining their ecological, environmental, and hydrological integrity (UNESCO, 1999). Improved water management may reduce expenditures for energy, chemicals, and labor, while enhancing revenues through higher crop yields and improved crop quality. Strategic IWM may also enable a country to better resilient the risks of famine and drought (AREI, 2006). Agriculture, which accounts for about 90 percent of freshwater consumption in the Western States and over 80 percent nationwide, is increasingly being asked to use less water in order to meet societal demands for other uses (AREI, 2006). Improved water management practices may also reduce the impact of irrigated production on offsite water quantity and quality, and conserve water for growing nonagricultural demands. Thus, efficient irrigation systems and water management practices can help maintain farm profitability in an era of increasingly limited and more costly water supplies. Irrigation water management is one of the crucial factors for the sustainability of irrigation systems. It involves irrigation scheme, agricultural, Social, institutional, water and environmental management activities (Yohannes, 2010). Irrigation water management involves determining when to irrigate, the amount of water to apply at each irrigation event and during each stage of plant, and operating and maintaining the irrigation system. The main management objective is to manage the production system for profit without compromising environment and in agreement with water availability. A major management activity involves irrigation scheduling or determining when and how much water to apply, considering the irrigation method and other field characteristics (Eduardo, 2009).

Sustainable irrigation systems imply balancing economic, social, and environmental benefits through implementation of development policies, programs, and projects that will not enhance one type of benefit at the cost of others (IWMI, 2001). As suggested by Batchelor (1999) and many others, there are several ways to improve physical and economic efficiency at the farm level □□□□□□ agronomic (for example, improving crop husbandry and

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cropping strategies □ technical (for example, installing an advanced irrigation system); □□ managerial (for example, adopting demand-based irrigation scheduling systems and better maintaining equipment); and □ institutional (for example, introducing water pricing and improving the legal environment). Sustainability is not a fixed and clearly defined objective, rather it is a goal that is always changing as knowledge and biophysical realities alter. In that sense, moving towards sustainability is a journey with an ever evolving destination. Irrigation, as the biggest water user in most regions of the world, is facing significant challenges in balancing social, economic and environmental needs for water.

2.1.1. Economic Sustainability of Irrigation

As described by Eduardo, 2009, Irrigation has played a major role in poverty reduction in the past, even though the benefits were not always equitable. Irrigated agriculture will continue to be the main source of food supplies and employment for the poor. But the vitality of this sector is declining with growing scarcity and competition for water and increasing over exploitation and degradation of groundwater. Three conditions must be met to restore the pro-poor economic potential of irrigated agriculture: productivity, equity and sustainability. As cited by IWMI, 2001, the productivity of irrigated agriculture is substantially below its potential, with significant variation within and across countries. Low productivity in irrigated agriculture is largely a consequence of inappropriate policies and weak management institutions, which were designed for very different conditions in the past. Moreover, the extent to which irrigation contributes directly to improving the lives of poor rural people is a function of proactive policies and effective support mechanisms aimed at promoting equity and people-centered development. Playán and Mateos (2006) mentioned that modernized irrigation systems at farm level implies selecting the appropriate irrigation system and strategy according to the water availability, the characteristics of climate, soil and crop, the economic and social circumstances, and the constraints of the distribution system. To maintain and improve economic acceptability, some regions will require investments both to enhance water supply capacity and to increase water use efficiency. Given all these considerations, the marginal benefit and marginal cost associated with irrigation development and management can be assessed. When the marginal benefit is less than the marginal cost,

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the irrigation practice loses its economic acceptability, which implies an unsustainable state (Ximing, 2001).

As reported from Asian experiences, by IWMI, 2001, despite the remarkable expansion of irrigated agriculture that brought dramatic increases in aggregate food production in the past three decades, there remain vast areas in the established irrigation systems where productivity and incomes of farmers remain generally low and highly variable. This is attributed to a number of factors, including inequitable access to water, poor management, and a range of other physical, socio-cultural, and economic constraints. The efforts of developing country governments to address poverty reduction in these specific areas have been limited and ineffective due to lack of proactive policies and actions, and knowledge of how alternative economic, institutional, governance, and technical interventions can address poverty related constraints. But the benefits of irrigation have resulted in lower food prices, higher employment and more rapid agricultural and economic development. In general, Tafesse (2007), dictate that the potential contribution of irrigation towards farm output growth and the total beneficial impacts of irrigation development, both direct and indirect, can be summarized under the following categories:

- Increased crop production (yield improvement) and increased farm income.
- Increased cropping intensity and crop diversification opportunities and the feasibility of year round crop production activities.
- Increased farm employment; more employment opportunities for farming families as well as for hired laborers in the locality.
- Increased farm consumption and increased permanent capital (permanent asset accumulation due to irrigation). This has significant implication for reducing inherent food insecurity.
- Reduced food (crop) prices allowing access to food for all, which is more beneficial to landless and subsistence families and provides better nutrition intake.
- Increased access to farm link roads
- Multiple uses of water for washing, livestock and home gardens.

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- Increased recharge of groundwater, easy access to groundwater and less drudgery for women in fetching water for daily household needs.
- Visual and recreational benefits accrue out of irrigation facilities.
- Increased farm income (for farmers) and increased on farm and off-farm employment opportunities for rural landless laborers resulting in better school attendance of children of farm laborers and improved social capital in society. This is due to the income effects of irrigation.
- Improved rural infrastructure always coincides with irrigation facilities. This greatly reduces transaction costs and rural marketing costs. The benefits generated by these activities are also called indirect benefits of irrigation investments. Nevertheless, losing to maintain these benefits of irrigation will put the sustainability of the scheme under question.

2.1.2. Technical sustainability of irrigation

Irrigation system design substantially affects application efficiency and involves numerous variables and restrictions, whose principal objective is to maximize benefits and minimize costs. In a successful irrigation system, a set of resources produces maximum returns. To achieve this, optimization process supporting the design and operation of water application systems in agriculture is required due to many possible combinations of design variables that satisfy irrigation conditions (Eduardo, 2009). Irrigation systems have specific applications that are based on several factors, among which the most relevant are the crop, soil type, topography, and water availability and quality. The application efficiency of the different surface and pressurized irrigation methods varies and depends on design, management, and operation. Undoubtedly, well-designed and correctly used irrigation systems will have the highest efficiency and water distribution levels, which can result in a good production and high product quality. Water availability for irrigation is increasingly constrained. Irrigation accounts for 85 percent of water withdrawals in developing countries, and the rapid growth of the sector has been based on the availability of these huge quantities of low-cost water. Now rising demand for agricultural water faces increased demand from domestic and industrial uses. Many areas are already enduring competition for water and rising marginal

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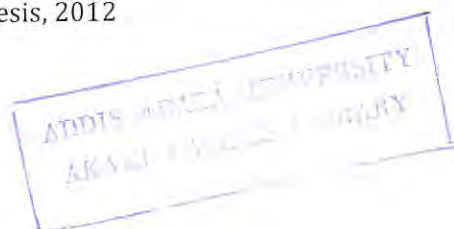
costs. For years, groundwater provided a profitable new resource, but in many basins groundwater is now being mined rapidly (World Bank, 2006). And thus Water resources management is changing, and environmental and social concerns are growing. Responses to growing scarcity, to increased competition among sectors, and to growing environmental and social concerns include integrated and basin management approaches and demand management measures. On the supply side, there are fewer new diversion and storage projects, and more consideration of reuse of wastewater and drainage water. Climate change is increasing the existing vulnerability of farmers. Investment policies are starting to move toward upgrading and management improvements, although very slowly. Consideration of the environmental and social impacts is becoming an important factor in AWM; with broader understanding of the multi functionality of water and of human and ecosystem interactions: Environmental and social concerns are increasingly mainstreamed (World Bank, 2006). Water use efficiency is not only the quantity and quality of water applied but also the quantity and quality of intelligence applied in managing, using, and in conserving the resources.

Hamdy (2000) said "It is not the quantity of water applied to a crop, it is the quantity of intelligence applied which determines the result - there is more due to intelligence than water in every case". Water use efficiency includes any measures that reduce the amount of water used per unit of any given activity, consistence with maintenance or enhancement of water quality (Hamdy, 2000). The efficiency of water use is affected by decisions made at many levels. In a context where water scarcity will certainly emerge as the key constraint to agricultural production, there is a pressing need to achieve a substantially more efficient and productive use of water in irrigation. Addressing this need, however, requires a better understanding of the water balance within irrigation projects. In particular, the recycling of irrigation return flows (the non-consumptive 'losses' occurring as canal seepage, surface runoff and deep percolation), which often plays a key role in water-scarce areas needs more careful consideration (IWMI, 2002). Improving the efficiency and effectiveness of water use can result from better managing a number of factors, including water availability, fertility, pests and diseases, crop or pasture variety, planting date, soil water conditions at planting, plant density and row spacing. This means that improving water use efficiency requires an understanding of the whole system and should not focus solely on the application of water. Optimizing the agronomic factors that may contribute to improved use of water (crop and

variety selection, planting date, tillage, fertilizer application and harvest techniques) may conflict with minimizing water losses. Maximizing rainfall effectiveness and optimizing the use of stored soil water may be as important as minimizing irrigation losses. Generally, for a fixed production system, the system with the lowest losses will have the highest water use efficiency. When assessing efficiencies it is not only the physical aspects of the irrigation system that are of concern but also other emergent properties, such as the service industries that develop as a direct result of the presence of the irrigation scheme. Considering these factors adds to the complexity of an already complex problem but highlights the need for a multidisciplinary approach that considers the economic and social aspects as well as the physical. Water management is an important element of irrigated crop production. Efficient irrigation systems and water management practices can help maintain farm profitability in an era of limited, higher-cost water supplies. Efficient water management may also reduce the impact of irrigated production on offsite water quantity and quality. However, measures to increase water-use efficiency may not be sufficient to achieve environmental goals in the absence of other adjustments within the irrigated sector. As is often the case, technology is not the whole solution anywhere, but part of the solution almost everywhere (*Marcel Aillery, 2002*).

2.1.3 Environmental Sustainability of Irrigation

The interdisciplinary nature of water resources problems requires the integration of technical, economic, environmental, social, and legal aspects into a coherent analytical framework, so that both economic and environmental consequences of policy choices can be examined. Sustainable irrigation water management should simultaneously achieve two objectives: sustaining irrigated agriculture for food security and preserving the associated natural environment. A stable relationship should be maintained between these two objectives now and in the future, while potential conflicts between these objectives should be mitigated through appropriate irrigation practices (Ximing, 2001). The purpose of sustainable water resources management is to sustain both the water supply capability and the environment, now and in the future. Water supply capability encompasses both the availability of water and the infrastructure to sustain water supply and use. Impacts associated with implementation and running of irrigation projects are likely to be manifested on both natural



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and social environment. The consequences of none operating or poorly managed irrigation projects on the environment weighs far bigger than their ultimate benefits. Agricultural practices have to be sustained at least to guarantee the anticipated food production without compromising environmental issues (FAO, 2007). Usually Irrigation projects are designed and implemented keeping in mind only there economics (FAO, 2007).Both excessive and inadequate water application have negative environmental effects. Irrigation and water resource development can also cause social and environmental problems (Stockle, 2003). Irrigation represents an alteration of the natural conditions of the landscape by extracting water from an available source, adding water to fields where there was none or little before, and introducing man-made structures and features to extract, transfer and dispose of water. Irrigation projects and irrigated agriculture practices can impact the environment in a variety of ways. The environmental impact of irrigation systems depends on the nature of the water source, the quality of the water, and how water is delivered to the irrigated land. Withdrawing ground-water may cause the land to subside, aquifers to become saline, or may accelerate other types of ground-water pollution. Withdrawing surface water implies changes to the natural hydrology of rivers and water streams, changes to water temperature, and other alterations to the natural conditions, sometimes deeply affecting the aquatic ecosystems associated with this water bodies. An excessive withdrawal of water for irrigation is clearly impacting the environment in some areas (Stockle, 2003). Pressure on the environment from human and economic activities, lead to changes in the state or environmental conditions that prevail as a result of that pressure, and may provoke responses by society to change the pressures and state of the environment(OECD,1999).In many locations around the world, strains upon the environment are occurring increasingly and concern is mounting about the sustainability of irrigated agriculture due to water-logging, Salinity, erosion, desertification, and loss of biological diversity, waterborne diseases, and the adverse effects of potentially toxic agricultural chemicals up on human health and the biota of associated ecosystems. FAO has summarized some of the challenges faced by present-day irrigated agriculture as follows:

- 1) More efficient use of inputs (water, fertilizer, pesticides, and labor) aimed at reducing negative impacts on the environment and production costs;
- 2) Soil salinity, matching landscape capability with irrigation systems when deciding on new locations for irrigation development or on-farm field suitability;

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- 3) Minimizing environmental impacts by quantifying both positive and negative externalities of different irrigation areas and sectors, and by evaluation, auditing, and benchmarking in the irrigation industry. Management of negative environmental impacts, such as methane and nitrous oxide emission, salinity, water pollution (abuse of pesticides), algal blooms, etc., especially in intensive crop production systems;
- 4) Balancing irrigation and environmental flow demands through real savings due to improved distribution and on-farm water use efficiency and alternative cropping options;
- 5) Maintaining and enhancing drainage water quality, and minimizing impacts on rivers and ecosystems;
- 6) Institutional robustness in terms of the failure of the institution and ecosystem through better definition of property rights (FAO, 2000; World Bank, 2007). Analysis of the environmental effects of irrigated agriculture needs to take into account the dynamic processes of all the interactions in the watershed and recognize the driving forces (population growth, climate change, land use, urbanization, and market impacts). Soil and water monitoring is required. Research institutes should construct the framework for monitoring with the long-term support of governments. An interdisciplinary approach is required to understand the processes in the watershed by taking into consideration water availability, water demand, and water quality at the basin scale, and taking into account the demands of other users. The establishment of an appropriate baseline, as well as the design of future scenarios is important.

As cited by Tafesse, 2007 from (Dessalegn, 1999) Irrigation schemes not only have positive externalities but also create negative externalities to the surrounding environment. Dams interfere with the flow regime of rivers, causing losses to communities' down-stream; they have also been known to increase the incidence of flooding. Reservoirs may change the local environment; the local vegetation cover may be replaced with other species, which may be of less value to the surrounding population. Water impoundment has frequently been accompanied by serious health hazards. One of the most serious environmental hazards caused by irrigation schemes is salinization and the loss of valuable land caused by it. Poor water management and inadequate drainage invariably increase water salinity and water logging, and as the water evaporates a whitish salt residue is left on the soil. In its milder

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form, salinization will decrease the productivity of arable land and pasture, but in more serious cases it can ruin the land for good. As summarized by Wagnew 2004, the issues, which affect the sustainability of the schemes and environment, are considered to be the key issues that should be taken into account in managing and making future investments in the sub sector are listed as follows:

- Inefficient use of water
- Soil fertility and quality maintenance problems
- Soil salinity problems
- Soil erosion
- Water related disease hazards
- Relation with sustainability and irrigation development opportunities
- Displacement and land-use pattern changes etc.

2.1.4 Social and Institutional sustainability of Irrigation.

According to Mollinga (2003), irrigation requires the integration of both dimensions that are social and technical. Without the incorporation of institutional and other social relations such as human interest, rational decision-making, power relations, conflict, etc. to the technical irrigation discourse, it limits the comprehensive understanding of irrigation. It can thus be seen that the proper development and management of irrigation is a complex and comprehensive undertaking, requiring attention too much more than hydraulics and agronomy.

The water crisis is mainly a crisis of governance. Working towards effective water governance requires an enabling environment and appropriate institutional structures that allow stakeholders to work together for effective water management. Sustainable development of water resources and effective governance are inseparable. Water governance generally refers to the wide range of social, economic, political, institutional, administrative systems and decision-making processes. Such systems exist to regulate the development and

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management of water resources and provision of adequate, safe and reliable water supply services. The fact is that inadequacies and incompetence of institutional arrangements and legal frameworks do seriously affect water governance. The weaker the stance of water governance, the deeper is the crisis in water resources management and development (UNESCO, 2004). An understanding of water issues and of the support needed for investments, institutions, incentives, information and capacity inside the 'water sector' requires partnerships between those responsible for the economy wide benefits of water and those responsible for managing water (UNESCO,2009).

Huppert (1989) explained that irrigation is not simply a technical task of delivering water to crops. It is also a human activity and social undertaking. Rural households operate within a larger historical, socio cultural, economic and institutional and policy environment that makes the need for the linkages very important. Any farm system is a mixture of abstract and concrete elements. The concrete elements refer to physical activities and processes that occur on the farm while abstract elements relate to the managerial aspects of the farm. To be more specific, the concrete elements involve technical resources such as technology, knowledge of cropping system or the irrigation system and opportunity that is useful for irrigation. The abstract elements relate to the entire farm system through the farm management activity of setting goals, developing long and short-term plans, specifying organizational structure, deciding on enterprises, choosing technology, allocating resources, seizing opportunities, establishing control processes, harmonizing relations between sub-systems relevant to the farm (FAO 2003). Yohannes (2010) described that Participatory Irrigation Management schemes may superficially appear to be simple administrative measures but can in fact prove to be complex operations with far reaching social sequences. They must therefore be tailor-made for each situation and to ensure success, the social and cultural backgrounds of the population involved have to be considered. All these and other considerations show that the setting up of a participatory irrigation Management Scheme that may appear to an engineer or policy-maker to be a simple administrative and logistic measure can actually be a complex operation with far-reaching social consequences. The type of privatization or participation has to be tailor-made for each situation.

As cited by Sisay (2011), Community-based Irrigation Water Management or CBIWM focuses on the collective management of irrigation water to improve human well-being and poverty reduction. It aims to devolve authority of irrigation water management to the local

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(community) level, thereby empowering communities to manage their own resources without permanently damaging, depleting or degrading them. CBIWM, therefore, requires strong investments in capacity development and the development of local institutions and governance structures. Most approaches to irrigation planning and management so far have biased towards engineering and construction and tended to focus on achieving the most technically effective system of water distribution. They have taken less account of the managerial and social factor which will determine whether irrigation leads to efficient agricultural production or not (FAO, 1986). They have given less consideration for social interaction, and notions like interest, conflict and struggle. Mollinga criticizes past management and economics literature on irrigation and current approaches to irrigation studies for having three conceptual problems: lack of appreciation of the social dimension of technology, simplified concept of the human agency and little interest in social relations of power and the institutional forms through which purposes of irrigation are achieved. Additionally, the constraints that jeopardize success of irrigation, among others, include weak economic policies or institutions, lack of institutional capacity to manage or weak management and lack of clearly defined legal framework and faulty conflict resolution. Irrigation technologies require particular social conditions to work effectively (Mollinga, 2003). In relation to social requirement for use, it is important that there are management structures that suit the different irrigation technologies in use. The type of canal system in use determines the type of organization needed in an irrigation system. Irrigation technologies have social effects (Moltinga, 2003). Irrigation affects people's livelihoods through its effect on crop production. Irrigation allows more diversified and intensive cropping. This leads to higher agricultural production and increased income, which may, in turn, generate economic growth and employment. Molinga,2003 (as cited by Tafesse, 2007) also described that irrigation technologies not only mediate people's relationships with biophysical processes, but also shape the people-to-people or group of people to group relationships that are ingredients of irrigation practices. He noted that the socio-economic dimensions of irrigation are based on the following considerations:

1. For the irrigation technologies to work properly, particular social and economic conditions are necessary.

2. The development of irrigation technology requires social construction in which different parties or stakeholders interact (communicate, negotiate, take decisions, struggle, work together etc).

3. Irrigation technologies have social effects, i.e. through their effects on crop production, people's health, education etc.; irrigation can affect people's livelihoods

There could be conflict between irrigation and other activities in the allocation of family labor. There may be conflict in the choice of crops. An ill-designed canal system limits farmer's access to water (Woldeab, 2003). Scarcity of water breeds conflict due to competition. Un-reliability of water supply discourages and /or imputes farmer's participation (Woldeab, 2003).

2.2. Conceptual Frame work

Howell (2001), presents **four** options for assessing irrigation sustainability, which are based on **socio-economic, Technical, and environmental** variables.

Socio-Economic factors include; Total physical product (TPP) per hectare, Profitability (Net farm income), Gross revenue, Total farm assets, Total hectare farmed, Crop value per hectare, Gross revenue per person, Labor cost per hectare and economic constraints such as Land Loss, Crop/Production loss, Aquaculture affection, Transport and market problem, Re-settlement, unemployment, and Community willingness were assessed.

Technical (Water management) components such as:

Agronomic; Crop management to enhance capture of rainfall or reduce water evaporation (E.g. crop residues, conservation till, and plant spacing's); improved varieties; advanced cropping strategies that maximize cropped area during periods of lower water demands or periods when rainfall may have greater likelihood of occurrence or both.

Engineering; Irrigation systems that reduce application losses, improve distribution uniformity, or both; cropping systems that can enhance rainfall capture (e.g. crop residues, deep chiseling or Semi-tilling, furrow dyke and pitting).

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Farm Management; Demand-based irrigation scheduling; slight to moderate deficit irrigation to promote deeper soil water extraction; avoiding root zone salinity yield thresholds; and preventive equipment maintenance to reduce unexpected equipment failures.

Institutional; User participation in an irrigation district (or scheme) operation and maintenance; water pricing and legal incentives to reduce water use and penalties for inefficient use; and training and educational opportunities for learning newer, advanced techniques. And the other factor that highly affects sustainability is:-

Environmental; factors such as watershed management, Land and soil productivity which is declined with years of irrigation, Turbidity of irrigation water, Seepage, ground water level rise, dampening of the microclimate, malaria, skin diseases and common cold, Sediment transport, Aquatic Weeds ,Species diversity, Endangered species etc are some of the variables seen in detail.

Therefore, Irrigation development is not only construction of structures to convey water to the farm and to produce crop using the diverted water, it also requires the social, economic and environmental benefits balancing without compromising the benefit of one on other. Integration of all these entities is required for sustainable irrigation development. This is the analytical sight of this study, in other word the feasibility and sustainability of any irrigation system is at the whole sum functions of socio-economic, environmental and water management practices. See figure 1.

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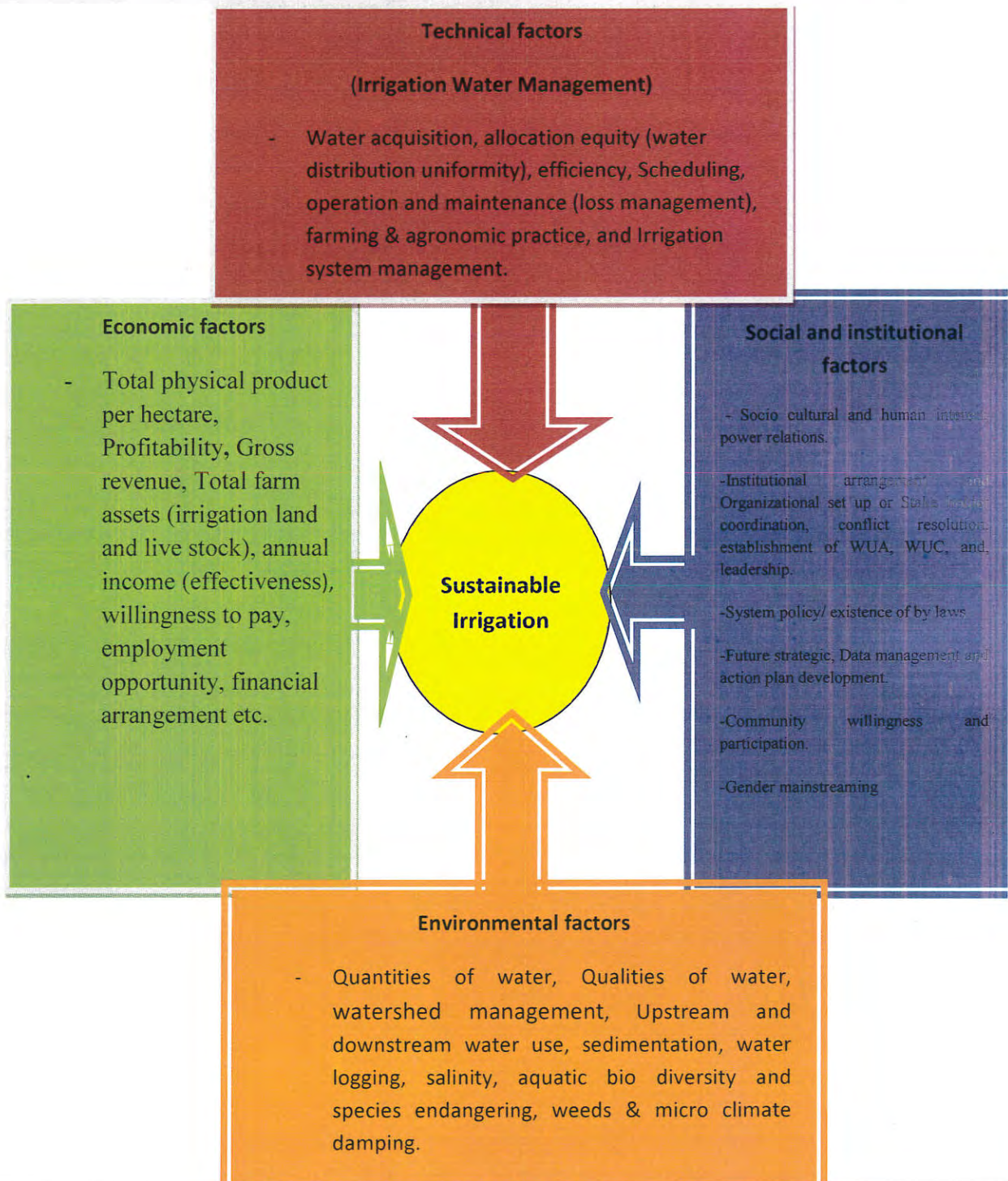


Figure 1 : Conceptual frame work: Sustainable irrigation system, (compiled and developed from literatures)

3. Area Description and Methodology

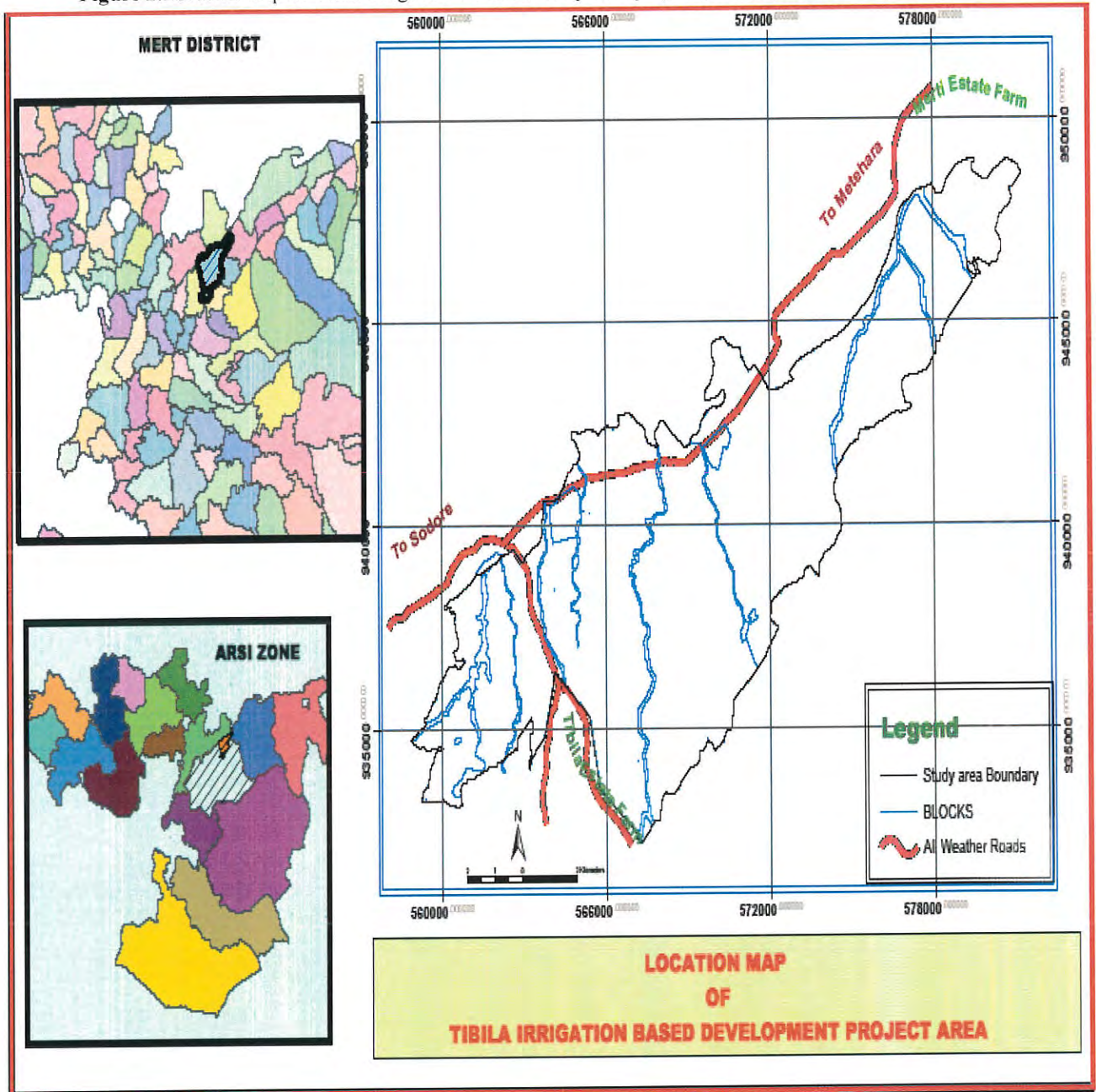
3.1. Description of Study Area

3.1.1 Location

Tibila Irrigation Based Development Project is located at an air distance of 130 km south east of Addis Ababa, in the northern-central part of the Main Ethiopian Rift (MER). It is an integrated irrigation based development project located in Oromia region of Ethiopia; Arsi Zone at Sire, Jaju and Merti Wereda's. It is a large scale irrigation project (LSIP) designed to produce in an area of about 7000ha. Currently the project is under implementation and about 75% were already completed and about 2000 peoples are using the scheme. The water for the areas is diverted from Awash River at 5km from the upper reaches of the command. The system comprises of diversion intake, main & branch canal systems, control structures, division boxes, and bridges, cross drainages, Culverts, distribution systems, storages and drainage systems. More than 16,000 households are using the system for producing crops, fruits and vegetables (OWWDSE, 2009) when fully completed. It is implemented by the regional government of Oromia. Six kebele administrations by kebele level have been incorporated in the project area of these three districts. See fig 2 below

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Figure 2. Location map of Tibila Irrigation based Development project (Source, OWWDSE, 2009).



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3.1.2 Demographic Characteristics of the Area

According to the available crude data obtained from the respective districts, there were about 17351 people incorporated into 3258 households in the six kebeles of the project area, and hence, about 5 persons were living per household in the area at the time of the survey.

Table 1: Population size of the kebeles in the irrigation project area of Jeju district

Kebele name	Households			Population size		
	Male	Female	Total	Male	Female	Total
Achamo Gulo	285	40	325	988	1034	2022
Alaaga Dore	402	57	459	1293	818	2111
Huruta Dore	615	114	729	1754	1630	3384
Sokie Boqicha	585	96	681	2186	2002	4188
Total	1887	307	2194	6221	5484	11705

Source: Jeju district Administration office

Table 2: Population size of Koloba Hawas kebele of Sire and Watichadole kebele of Merti district

District name	Kebele name	Total household	Total population
Sire	Koloba Hawas	575	3057
Merti	Watichadole	489	2589
Total		1064	5646

Source: District Agriculture and Rural Development offices.

Table 3: Total population in the six kebeles of the irrigation project area

District name	Kebele name	Total household	Population size	Average number of persons/HH
Jeju	Achamogulo	575	3057	5.3
	Alagadore	489	2589	5.3
	Hurutadore	325	2022	6.2
	Sokieboqicha	459	2111	4.6
Sire	Koloba hawas	729	3384	4.6
Merti	Watichadole	681	4188	6.1
Total		3258	17351	5.3

Source: District Agriculture and Rural Development & Administration offices.

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As indicated in the table 3, about 67.6% of the assumed beneficiaries were from the four kebeles of Jeju district, while about 17.6% and 15% were from the remaining kebeles of Sire and Merti districts of Arsi zone respectively. The six kebeles, from the three districts that were incorporated into the irrigation development project of Tibila were Achamogulo, Alagadore, Hurutadore and Sokieboqicha from Jeju district and Koloba Hawas and Watichadole kebeles from Sire and Merti districts respectively. All the households in these kebeles may not be the beneficiaries.

3.1.3 Climate conditions of the area

The climate is characterized by a long dry season and two rainy season, which occurs from March to May (short rain season) and from June to September (long rainy season). Annual rainfall in the project area is about 670mm. Mean monthly rainfall varies from 5 mm to 172mm. The highest rainfall occurs in August; while the lowest rainfall occurs in December. Mean monthly relative humidity varies from 30% to 49%. The mean monthly minimum and maximum temperature ranges from 9⁰ to 25°C respectively. The mean minimum temperature is recorded in December and the maximum is recorded in May. May and June are the hottest months of the year (OWWDSE, 2009).

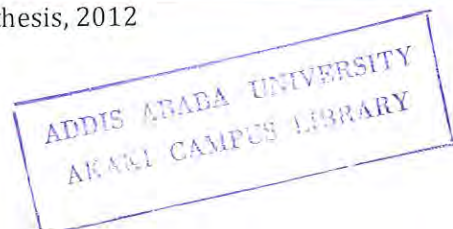
3.1.4 Water Resources of the Area

The source of water for the river is Awash. The river Awash emanates at an elevation of about 3000 m in the central Ethiopian Highlands, west of Addis Ababa, west Shewa near Ginchi town and flows northeastwards along the Rift Valley into Afar where it terminates in Lake Abe at an elevation of 250 meters (Awulachew, et.al, 2007). The main river length is about 1200 km. The mean annual flow is about 4.9BMC water in the river.

3.2. Methods of Data collection

3.2.1 Data Sampling.

Both qualitative and quantitative methods were employed in this research to analyze the problems. The data have both quantitative and qualitative nature. A stratified sampling method based on administrative and irrigation system layout was used. As stated above,



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TIBIDP covers three districts of Arsi Zone. Therefore, the data collection covered all of them. In each district the sample was taken from three segments at upstream, middle level and downstream scheme users. With this stratified sampling system throughout the whole scheme data were gathered at nine locations from 12 households in each location. Thus, the total numbers of respondents were 110 households. The number of respondents in each location was determined based on area coverage of the scheme in the district with equal number of respondent at up, middle and downstream in the district of concern or in each district. In each locations the respondent were randomly selected. Currently about 2000 farmers are producing with the scheme on about 1200 ha of land from block 1 to block 5. See figure 3.

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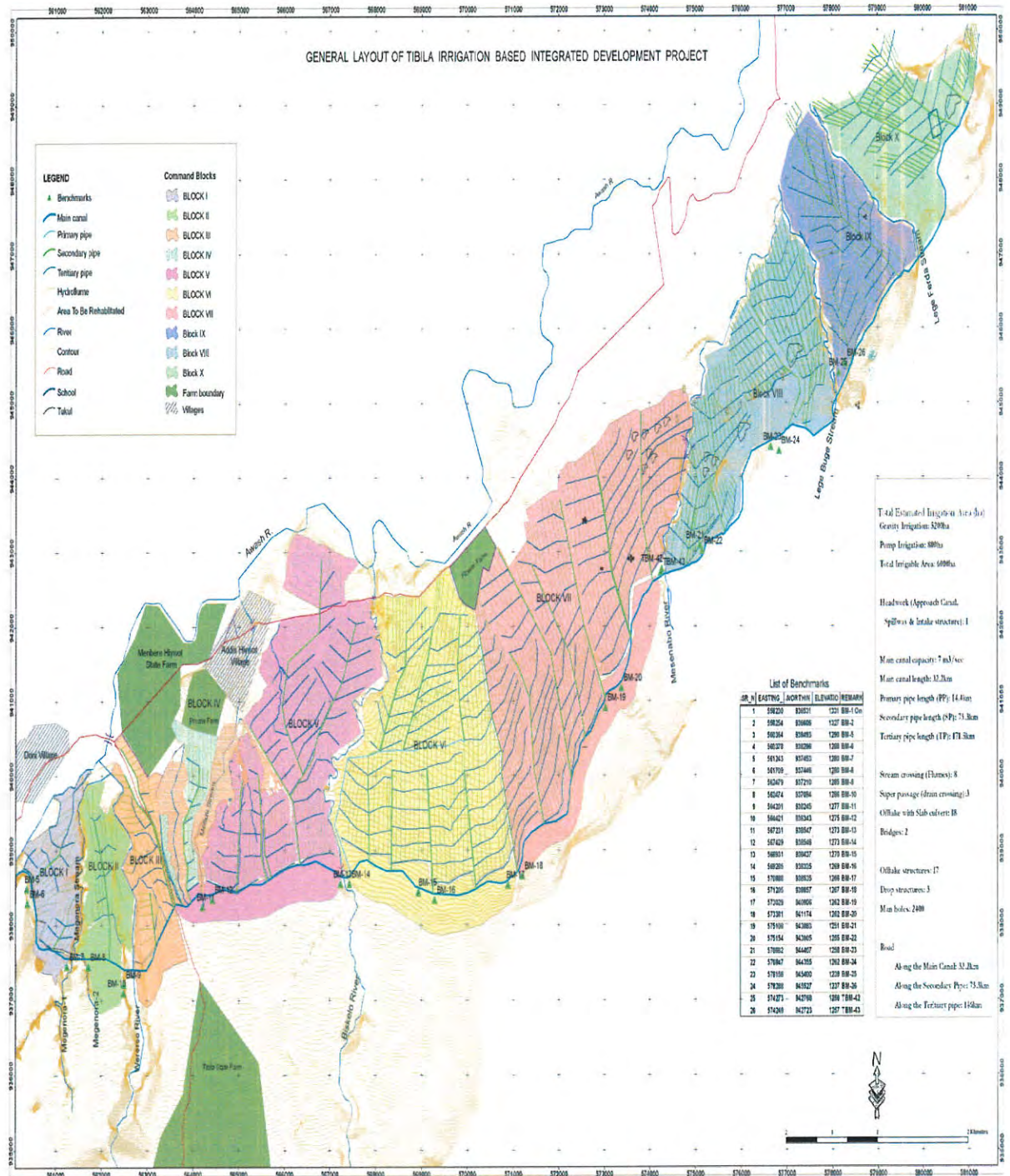


Figure 3. Tibila irrigation system lay out (source: - OWWDSE, 2010).

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Table4. A table showing Sampling Design

District	No of sample respondent			
	Up stream	Middle level	Down stream	Total
Jaju	12	12	14*	38
Sire	12	12	12	36
Merti	12	14*	10*	36
Total	36	36	38	110

**Note; the data collection in each district takes the irrigation land area coverage into consideration. Jaju district downstream and Merti middle level area are relatively wider and Merti downstream area is smaller than the others.*

3.2.2 Primary Data

Primary data were collected using various instruments such as key informant interview using semi-structured checklist, group discussion, expert interview, structured questionnaire and observation of events in the irrigation systems.

3.2.3 Secondary Data

The main sources of secondary data were published and unpublished documents. These included policy statements, proclamations and regulations, project appraisal documents, reports and past case study papers on irrigation.

Interview

This was conducted to collect primary data on the beneficiary attitude towards the irrigation project and the water management. In this interview questions related to the efficiency, effectiveness and Delivery performance were raised. In addition, matters related to Institutions were also part of the interview. In general the interview was conducted in, structured, semi structured and unstructured formats .In structured formats, questions were designed and distributed to collect information.

Key Informants interview

This method was employed especially to get the overall information about the research area and their attitude about the project past and current status and their future expectation. List of topics which can help for this method were designed and prepared. Observations about the project area were also made. Challenges and success theories were discussed with key informants.

Focus Group Discussion

According to Yohannes (2010) Focus group discussions are a powerful method for collecting information relatively quickly. They are better suited for exploring norms, beliefs, practices, and language than for seeking information on actual behaviors or details of individual lives. Focus group was designed in terms of purpose, size, composition, and procedures. These focus groups were composed of ten individuals selected by characteristics that are relevant to the topic discussed. They were from district, zonal, water users' committee members and project offices. The views, opinions, and out puts of the discussion were presented in the result and discussion section.

3.3 Methods of Data analysis

Data processing & analysis using different tools such as statistical calculation, descriptive and qualitative interpretation was applied to compare, propose and to develop the possible mechanisms for effective & efficient resource use and management.

3.3.1 Qualitative

Qualitative analysis uses qualitative information obtained from a literature review, interview, or a focus group discussion etc. The basic qualitative analysis methods include; Explain the Situation: convey to readers the whole picture of the intervention including what is happening in the area, how stakeholders were perceiving the intervention, and in what situation specific activities or events are being implemented and classify information

according to patterns and issues i.e. find out information or the results of observations that can be classified under the same issue or concept and bring them together in a group and also examine relationships within information to know cause and effects on each other.

3.3.2 Quantitative

Different Quantitative analysis techniques: Simple Aggregation such as frequency, standard deviation, averages and percentage distribution and measures of differences and associations were used to analyze the quantitative data as values of the variables were presented in result and discussion section below using SPSS 19, IBM soft ware.

4. Result & Discussion

This chapter is a discussion on results of the study.

4.1. Socioeconomic Profile of the Study Site

4.1.1 Total farm asset of the area

Agriculture is the main economic activity that employed the majority of farmers in the study area. Smallholder mixed crop livestock farming is the dominant mode of production in the districts. Some Farmers traditionally practice irrigated agriculture by diverting the available rivers by traditional means, especially in Jaju and Merti district. Before construction of Tibila Irrigation scheme, farmers in the area used to practice irrigation in small scale and there is also Tibila state farm producing fruits and vegetables in the vicinities of the scheme. These farmers irrigated crops such as maize, sorghum, potato, hot pepper, tomato, and other different vegetables. In spite of farmers' experience and growing interest in irrigation, no significant area, relative to the potential, has been developed using traditional irrigation due to technical difficulties and topography problem to divert the Awash River and lack of financial Resources.

Livestock play a key role in day –to-day life of farmers. Oxen are the main source of draft power for cultivation and farmers with no oxen are considered as poor. Family labor is free during the dry season as farmers in the area do not have alternative employment opportunities, other than rain-fed agriculture during the main rainy season. The major source of livelihood in the area appears to both crop and livestock production, which is one of the main characteristics of mixed farming system.

According to OWWDSE, 2009, about 95.3% of the sample households reported that they are engaged in both livestock and crop production. Only about 4.7% reported that they were exclusively engaged in crop production. Thus, the predominant form of farming in the irrigation project area is mixed farming system. In addition to crop production, the people in the area have also engaged in livestock rearing and production. As is already known different types of livestock are used for various purposes. In one way or another, livestock can augment the income of the people. In this aspect major livestock that are available both in the districts of Jeju, Sire and Merti include cattle, goats, sheep, camel, equines and poultry.

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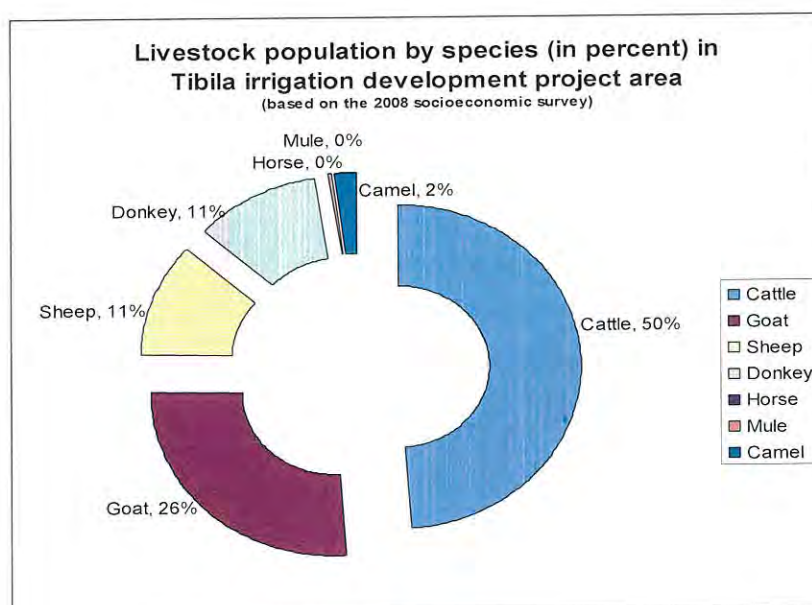
Table 5: Livestock population by species in Tibila irrigation project area (poultry included)

District	Kebele	Livestock type								Total
		Cattle	Goat	Sheep	Donkey	Horse	Mule	Camel	Poultry	
Jeju	Achamogulo	1223	813	204	343	0	5	45	901	3534
	Alagadore	3425	1572	825	743	0	5	257	1441	8268
	Hurutadore	5250	2000	1200	1300	5	10	200	5095	15060
	Sokieboqicha	3325	1913	897	702	7	13	62	1781	8700
Sire	Megacha	1345	1552	240	275	4	3	22	435	3876
Merti	Watichadole	Na*	Na	Na	Na	Na	Na	Na	Na	Na
Total		14,568	7,850	3,366	3,363	16	36	586	9,653	39,438

Source: Districts Agriculture and Rural Development offices (OWWDSE, 2009).

*Na – not available

Graph 1, livestock population of the area



(Source: - districts survey data, 2008).

According to the data obtained from Agriculture and Rural Development offices of Jeju, Sire and Merti, crops grown in each of the districts as well as the irrigation project kebeles

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include various types of cereals, pulses and horticulture among others. Hence, maize, sorghum, teff, wheat, barely, oats, onion, potato, tomato, etc. are grown in the area. Despite the various constraints that hindered agricultural production, the rural people in the project areas and the surrounding areas, are mainly engaged in crop cultivation to sustain their life. Therefore, crop cultivation is the main source of income or livelihood source in the project area.

Table 6, Farmers crop cultivation intention

Type of crop	Number of respondents	Percent
Maize	139	82.2
Teff	87	51.5
Sorghum	26	15.4
Wheat	16	9.5
Barely	5	3.0
Tomato	139	82.2
Potato	45	26.6
Onion	153	90.5

Source: From OWWDSE, Field survey 2009

It is readily understood that education has got a paramount importance in facilitating development intervention and various development activities in an area. Furthermore, education has a great role to play in the enhancement and development of human capital in a country. Education is also fundamental to the enhancement of the quality of human life and ensuring social and economic progress. It facilitates information dissemination regarding modern agricultural technology, input utilization technical knowhow, environmental preservation and sustainable development in the rural areas at large. From the field survey made during data collection, out of the total sample interviewed, about 52% were literate and 48% were illiterate as can be seen in the table 7.

Table 7, farmers Class level of education (Source- interview data)

Education level	Number	Percent
literate	58	52
illiterate	52	48

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The land resource in the area in general has been categorized into various types as indicated in table 8.

Table 8: Total land use pattern in project kebeles of Jeju, Sire and Merti districts

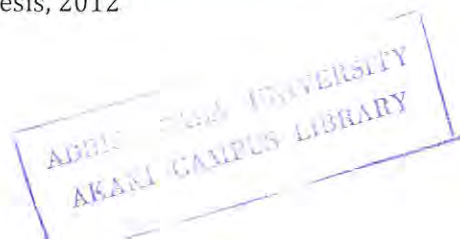
Land use pattern	Area in hectare	Percent
Arable land	23891	54.0
Pastureland	7677	17.0
Forest land	7275	16.0
Wood land	2708	6.0
Built up area	18	0.04
Irrigated land	200	0.4
Wasteland	705	2.0
Unidentified	2232	5.0
Total	44706	100

Source: Computed from the three Districts Agriculture and Rural Development offices.

The irrigation land holding in the project area is relatively better when compared to other high land areas of Oromia region at large. As can be observed from the table 9 a large number of the 110 sample households in irrigation project area have indicated that they 'owned'/held significant size of irrigation farmland. The land classification is 0.25ha, 0.50ha or 0.75ha in irrigation area as shown in the table below and it is based on age and family size as reported by the respondent. Youths are supposed to take only 0.5ha of land. While females and few family holders were given 0.5ha and mother farmers as they are calling given about 0.75ha which is the biggest irrigation land share in the region's irrigation land tenure.

Table 9; the respondents' Irrigation land tenure (Source- field survey)

Irrigation land in ha	Number	percent
0.25	39	35.5
0.50	31	28.1
0.75	39	35.5



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Table 10 Annual income for different land size

	Irrigation land in ha		Income in birr
annual income from irrigation	0.25	Mean	10746.15
	0.50	Mean	16516.12
	0.75	Mean	28205.12

The average annual income of the sample households were significantly varies with land holding size See table 10.

From table 11 it can be concluded that education plays significant role in income improvement. For any development project sustainability, capacity building is inevitable.

Table 11, Average income differences of literates and illiterates (Source- survey data)

Item	class level of education		Income in birr
annual income from irrigation	literate	Mean	19,346.55
	illiterate	Mean	17,865.38

Market availability and accessibility be considered as some of the important infrastructures and services for any development endeavor in a given area. Accordingly attempt has been made identify marketing opportunities with regard to livestock and crop production. In this regard the possible accessible market (both for livestock and crop production) locations for people in and around the irrigation project areas include Abomsa, Bole, Doni, Metahara, Walinchiti, Asela, and Adama towns. Arboye town of Jeju district is also another possible market for agricultural production in the area. In fact the assumed beneficiaries of the irrigation project in Koloba Hawas kebele of Sire district complained that the only possible nearest market for them is Doni (Rural town), and they think that they may encounter access to market for their agricultural production. The major challenge that the majority of the respondent gave on market is lack of organizational arrangement and poor storage facilities for their products, see the table 12.

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Table 12 Challenges of the market in the area

Major Market challenge	Number	Percent
market distortion/debagging	11	10.0
information gap	37	33.6
lack of access	14	12.7
lack of organizational arrangement	48	43.6
Total	110	100.0

Source- survey data

In most developing countries including our nation/ Ethiopia/, the main power sources of production is human labour and oxen power. The economies of these nations are highly dependent on these power sources (IWMI, 2007). As parts of the nation, Oromia Region experiences the same production techniques to secure regional household economy. Almost all-rural populations of the region in general and project area in particular earn their living by manual labour. As compared to mechanized agriculture, manual labour requires mobilization of more human labour at a time for seasonal farm practices. Oxen power is the most important power source of the area next to human labour. This unskilled labour has been used for the last centuries and still in use without any modification and may be in use in the year to come (OWWDSE, 2009). From the field survey made with sample house hold, due to the intervention of the irrigation scheme, the labour force requirements of the farmers are increasing as can be seen in the table 13.

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Table 13. Farmers extra labour requirement's in the irrigation fields.

Labour power	Number	Percent
0	36	32.7
1	12	10.9
2	17	15.5
3	12	10.9
4	4	3.6
5	9	8.2
6	3	2.7
8	2	1.8
9	1	.9
10	8	7.3
12	3	2.7
15	2	1.8
20	1	.9
Total	110	100.0

Source – survey data.

About 60% of the sample respondent in the irrigation area requires more than two extra persons to work within their irrigation field as can be seen in table 13. Besides, all the respondents or 100% of the community are using oxen and man power for cultivation. Availability of ample productive working forces in the area is also another good opportunity for the success of the irrigation scheme. In other way round, irrigation development is one of the production technologies that absorbs or requires huge manpower and it is a big industry in the rural economy in creating job opportunities. Likewise, TIBIDP also creates good employment rate for the local dwellers. Almost the extra labour required is increased by 200% or becomes two fold as shown in the table 13.

4.2.2. Development potential and Characteristics of irrigators

Accordingly as summarized from the field survey and discussion the area has development potentials such as

- _ Presence of adequate land resource for agricultural production and development;
- _ Availability of a large number of livestock (different species);
- _ Large number of active working population currently dwelling in the area;
- _ Presence of people who are eager to be engaged in the irrigation development project (mainly to produce adequate food crops and cash crops for marketing);
- _ Relatively, a better location advantage, i.e. presence of large urban centers (such as Adama, Asela, etc.), in the nearest possible areas for marketing of agricultural products;
- _ Suitable climatic situation that can help fast growing of crops of various types;
- _ Presence of the already established small and large scale irrigation projects and agro industries in the adjacent areas which have an inspiring role in initiating and motivating the people dwelling in the areas of the ongoing irrigation development project;
- _ Fruits such as; mango, papaya, orange, etc are also said to be feasible in the area;
- _ In addition vegetables such as onion, potato, cabbage, carrot, garlic, etc. can be produced by the irrigation scheme when it is fully realized in the area;
- _ Creation of job opportunities when the irrigation development scheme is fully implemented; the general livelihood of the people will be improved; Overall social and economic development will be realized in the area. However, there are also development constraints such as;
 - _ there are no organized and well developed market in the area;
 - _ High intrusion of undesirable brokers that are engaged in distorting market prices of both livestock and crop production;
 - _ Low capacity in undertaking irrigation activities;

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- _ Low literacy rate in the area;
- _ Lack of technical and managerial skill to manage and use the modern irrigation scheme;
- _ Potential users of the irrigation scheme may face problem of obtaining vital inputs (such as chemical fertilizer, improved seed and pesticides);
- _ Shortage of potable water supply;
- _ Shortage of adequate road network; and low market access;
- _ since the area is very hot it is somewhat difficult to use oxen for cultivation in the area;
- _ Users of the irrigation scheme may lease their land and may lose the expected benefits, and this may expose them to exploitation;
- _ Low access and less control of the women in the area over resources, which obviously jeopardize the livelihood of the women; Lack of awareness regarding family planning, which has direct impact on undesirable population growth. Regardless of the above constraints, until now there are almost six water user associations organized on five blocks starting from block 1 to 5.

The organization arrangement follows irrigation system alignments i.e. each farmer on the field canal come together to form a group on tertiary canal and again the group on each tertiary, forms an associations on secondary or branch canal, in this way, all the farmers in the irrigation blocks are member of the water user associations. Ifa gudina, Abdi jiregna, xadacha balla, Abdi boru, birka dore and madda Gudina are the name given for the associations.

4.2.3. Effectiveness of the scheme

As Hamdy (2001) explained, improvements in IWM can help maintain the long-term viability of the irrigated agricultural sector. Water savings at the farm level can help offset the effect of rising water costs and restricted water supplies on producer income. Improved water management may also reduce expenditures for energy, chemicals, and labor inputs. while enhancing revenues through higher crop yields and improved crop quality. As the witnesses from FGD shows, the farmers of the area are producing three times a year. The

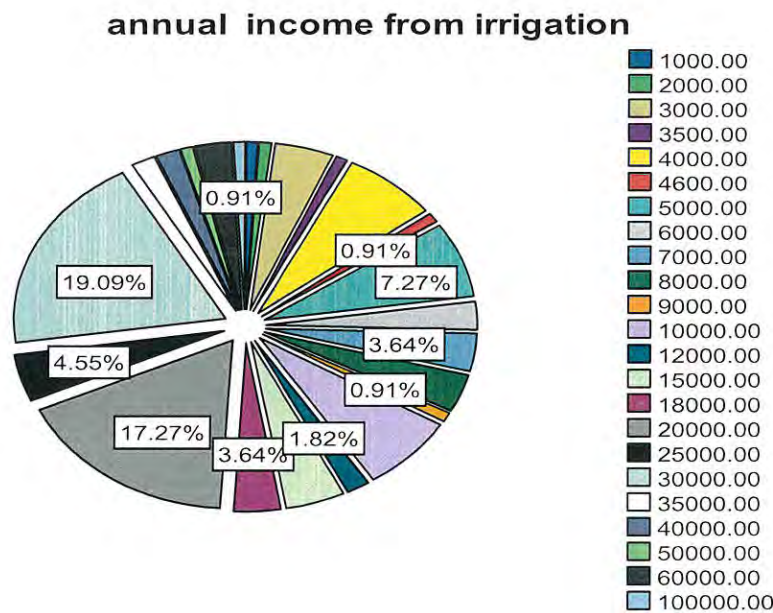
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climate is so hot that it helps the crops to grow and harvested faster relative to other areas. As indicated in the table 14, the rates of irrigation importance on income improvement show that, almost all, 99%, replied high and medium in their lively hood improvement. This shows that the importance of the project for the community is very crucial. This also guarantees its sustainability at large.

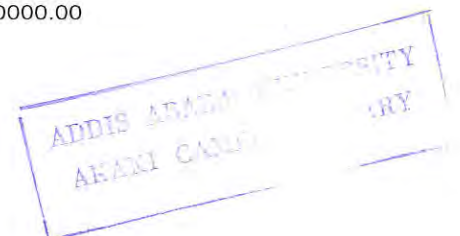
Table 14 , Rate of irrigation importance (source- survey data)

Rate of importance	Number	Percent
high	46	41.8
medium	63	57.3
low	1	.9
Total	110	100.0

Graph 2 Annual irrigation income ranges of the respondent.



Source: - survey data



4.3 Technical sustainability

4.3.1. Irrigation water management

Determining when and how much irrigation water to apply is an important part of the irrigation management process. Well-informed decisions increase the likelihood that water is applied according to crop needs, with minimal water loss. Improved management practices are often more cost-effective than structural improvements, although structural upgrades may be required to achieve highest management potential. From the field survey and interview made with the farmer shows that the water scheduling is not regular and its operation is as indicated in the table 15.

Table 15, Farmers practices of irrigation scheduling.

Irrigation Scheduling	Number	Percent
Using defined time interval	64	58.2
watering during water availability	11	10.0
using crop indicator	20	18.2
using soil indicator	13	11.8
not knowing scheduling	2	1.8
Total	110	100.0

Source - survey data

From the table 15, it can be seen that about 60% of the sample respondents were used to irrigate on defined time interval whatever climatic conditions are prevailing and 30% alone uses the indicators for irrigating the crops. The rest, 10%, do not know the principle and practices of scheduling. Therefore, scheduling and monitoring practices of the scheme, TIBIDP, requires a kind of capacity building and awareness creation to bring the intended result through efficient water management practices.

A doubling in global food demand projected for the next 50 years poses huge challenges for the sustainability of both food production and of terrestrial and aquatic ecosystems and the

services they provide to society. Agriculturalists are the principal managers of global useable lands and will shape, perhaps irreversibly, the surface of the Earth in the coming decades. New incentives and policies for ensuring the sustainability of agriculture and ecosystem services will be crucial if we are to meet the demands of improving yields without compromising environmental integrity or public health (David Tilman, 2002). Optimum management of available water resources at farm level is needed because of increasing demands, limited resources, water table variation in space and time, and soil contamination (Kumar and Singh, 2003). Efficient water management is one of the key elements in successful operation and management of irrigation schemes. Policies and strategies are also the key point for a country to have success full irrigation water management practices.

4.3.1.1 Water resource availability.

Awash basin is one of the intensively used river basin for irrigation water supply and hydro power development and the river is currently producing in more than 90,000 ha of land. Relatively, the most utilized river basin and the only river entirely in the country, awash covers parts of the Amhara, Oromia, Afar, Somali regional states, and Dire Dawa, and Addis Ababa City administrative states of the country. The river basin has a lowest elevation of 210 m and a highest elevation of 4195 m. The total mean annual flow from the river basins is estimated to be 4.9 BMC. In this river basin 37 irrigation potential sites are identified out of which 5 are small-scale, 18 are medium-scale, and 14 are large-scale. The estimated irrigation potential is 134,121 hectares. Out of these, a potential, 30,556 hectares are for small-scale, 24,500 hectares for medium-scale and 79,065 hectares for large-scale development (IWMI, 2007 1a). Un less efficient water use and management is practiced, the water shortage in the basin is highly significant. As discussed in FGD and interviews, the water scarcity in the basin especially during high peak period is the source of conflict now days. The reason of shortage as per the information collected, are water loses at different level which accounts about 34.5% of the respondent opinion, irrigation land expansion which is 29.1%, water use or need expansion which is 12.7% and population increments 9.1% as can be seen in the table 16.

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Table 16, Reason of water shortage in the area, basin

Reasons of shortage	Number	Percent
Valid	13	11.8
population increase	10	9.1
Irrigation land expansion	32	29.1
water use or need expansion	14	12.7
water scarcity in the basin	1	.9
water loses at different level	38	34.5
No response	2	1.8
Total	110	100.0

Source -field interview

4.3.1.2 Infrastructure functionality

For any irrigation water management to be effective, infrastructure functionality and design suitability plays a great role. As the analysis made on the interview report shows that the major challenges that made the system water management ill functional is as shown in the table 17. From the respondent and FGD, the functionality of the whole infrastructure is one of the crucial factor for irrigation system sustainability. TIBIDP is a large scale complex project that comprises many infrastructures in type and kind. It comprises big intake structure with control gates, main canal with geo membrane lined and many supper passages, drops, turn-outs, bridges, footpaths, flumes, branch canals, closed system distributaries (pipe systems), water division boxes or manholes and many other infrastructures.

Table 17 Major challenges that farmers face with the system facilities.

challenges	Number	Percent
Gates are not properly working	47	42.7
canals are not functioning well	18	16.4
no proper division and distribution system	45	40.9
Total	110	100.0

Source -survey data

4.3.1.3 Irrigation system management

The pursuit of sustainable agriculture will also require substantial increases in knowledge-intensive technologies that enhance scientifically sound decision making at the field level. This can be embedded in physical technology (for example, equipment and crop varieties) or in humans (for example, integrated pest management), but both are essential (David Tilman, 2002).

Sustainability of any irrigation scheme is achieved at the whole sum functions of system management. Irrigation system management implies abstraction or diversion system, conveyance system, distribution system and application system management. The management component of each function varies with type of irrigation technology, management options, ecology, and social norms and available institutions. As far as sustainability is concerned, irrigation system management which results in efficient and effective scheme is inevitable. The system management status of the project as tossed by the sample respondent is as shown in the table 18. About 36.4% of the respondent reported that the system management is good and the majority of the respondent, 61.8%, responded as medium and little few, 2%, said poor.

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Table 18. Responses of Farmers on system management status of the project.

	Number	Percent
good	40	36.4
medium	68	61.8
poor	2	1.8
Total	110	100.0

Source -survey data

4.3.1.4 Distribution Equity.

Equitable water distribution management of any irrigation scheme is the deciding factor for the sustainability and efficiency of an irrigation project, especially equitable or proportional sharing, based on adequate water plays great role for sound water distribution management. Two thirds of the respondents were complaining the distribution system challenge for equitable use. See the table 19.

Table 19 Responses on Distribution system problems in hindering equity of water use

Response	Number	Percent
yes	74	67.3
no	36	32.7
Total	110	100.0

Source - survey data

Water distribution equity is affected by many factors such as topography, system facilities, management options, crop and climatic conditions, and many more factors which are site and cultural specific. According to the interview made on the project and FGD discussant responded, in the whole scheme some of the major challenges that hinders equity in the command area are structure malfunction, topography, Financial power, system design problem, management problems and farm distance from the water channel etc. Out of the total sample respondent, about 38.2% were complaining about system design problem and 17.3% raised the issues of management within the scheme as can be seen in the table 20.

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Table 20 Farmers response on cause of in equality in water use on the farm

Cause of in equality	Number	Percent
Valid	7	6.4
structure malfunction	17	15.5
topography	17	15.5
Financial power	4	3.6
System design problem	42	38.2
management problems	19	17.3
nearness to the main water canal	4	3.6
Total	110	100.0

Source -survey data

Inequitable water resource use in the area is one of the causes of conflict. The major causes of conflict in the irrigation unit are water shortage that accounts 38.2%, water management problem, 16.4% and water theft which is 9.1% out of the respondents' response.

Table 21 Causes of conflict

Cause of conflict	Number	Percent
Valid	39	35.5
scarcity of water	42	38.2
Water management problem	18	16.4
water theft	10	9.1
No response	1	.9
Total	110	100.0

Source- survey data

4.3.1.5 Efficiency of the project

As eye witnesses, FGD and key informants' views, Tibila irrigation based development project has done many modifications and improvements to the scheme to improve the overall efficiency of the project. Pipe system for distribution, geo membrane to improve seepage

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from main and branch canals, and modified controlling and division structures are in use even if there are challenges with them. Criteria and procedures have been developed to improve and rationalize practices to apply water, through soil leveling, irrigation system design, discharge regulations, adduction structures, and control equipment. From the interview and key informant discussion, The major causes for in efficient irrigation water uses is water shortage in TIBIDP farm which could be results from poor water acquisition or allocation, poor or improper water distribution, poor management including poor operation and maintenance problem and mal functions of water conveyance system. From the table 22 it can be seen that poor water budgeting, 21.8%, and improper functioning of conveyance structures, scores the highest percentage in the sample respondents' response for the reason of water shortage in the farm.

Table 22 Reasons of water shortage in the farm (Source – field interviews.)

Reasons of water shortage	Number	Percent
Valid	30	27.3
no right water acquisition or allocation system	24	21.8
water is not properly distributed	12	10.9
management is poor	7	6.4
system operation is not well known by farmers	24	21.8
water conveyance system is not functioning well	13	11.8
Total	110	100.0

From the data presented below, it can be summarized as water loss at different level is one of the head challenges, 45%, for inefficiencies of the irrigation project.

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Table 23 Irrigation system efficiency challenge as perceived by farmers

Efficiency challenges	Number	Percent
Valid	15	13.6
water loss	50	45.5
system malfunction	22	20.0
poor water management	16	14.5
all	7	6.4
Total	110	100.0

Source: - field survey.

4.4. Environmental Conditions of Tibila Irrigation Based Development Project.

Agriculture is considered to be a significant contributor of water pollution by nonpoint sources. Diffuse pollution can arise from a range of activities on the farm, such as the leaching of fertilizers or soil erosion, which are spread out over a wide area and therefore harder to pinpoint and control. Many of the substances used in agriculture can cause water pollution (fertilizers, pesticides, manure and slurry, even the soil itself). Wise stewardship of water resources can help ensure to diminish the effect on agriculture practices on quality and availability of water resources. The major environmental variables that are considered in this study are water quality, salinity problem and its root cause, existence of water logging, up and down stream water use, erosion and sedimentation conditions, weeds problem and water shade management practices. Based on the data collected and the analysis made, the quality of water is almost good. As the analysis in the table 24 shows, 42.7% reports good, and 56.4% said medium.

Table 24. Quality of water

Quality status	Number	Percent
Valid Good	47	42.7
Medium	62	56.4
Bad	1	.9
Total	110	100.0

Source: - Survey data

Regarding the problem of salinity, there is no significant challenge reported by the farmers but among the possible causes of salinity farming practices such as fertilizer applications and

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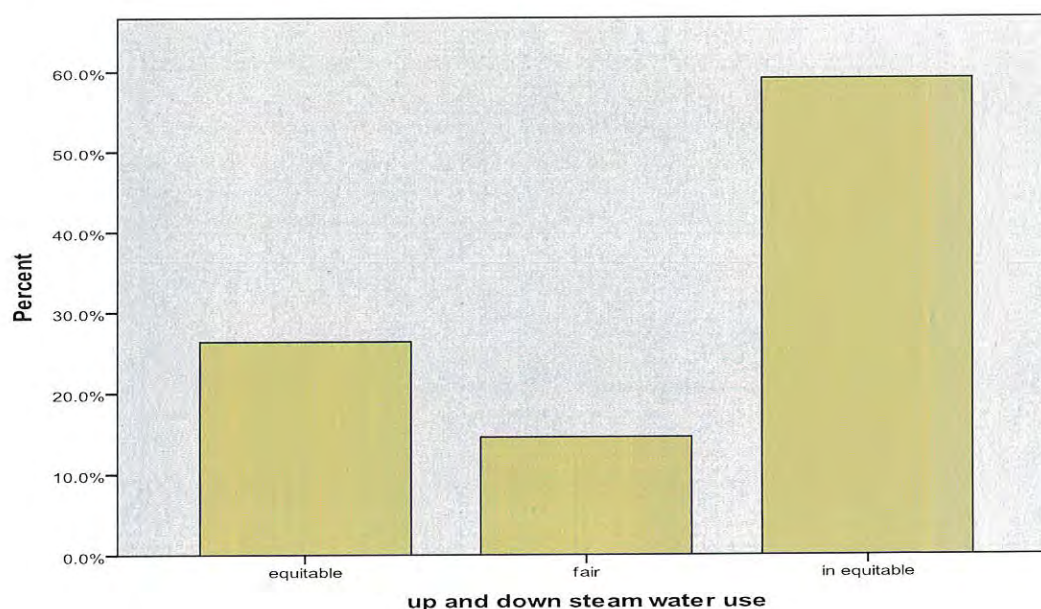
chemical uses accounts the highest share in the respondents' data analysis result. As can be seen in the table below, salinity problem due to farming practice is 28.2%, due to water is 11.8% and 17.3% is from land.

Table 25. Cause of salinity

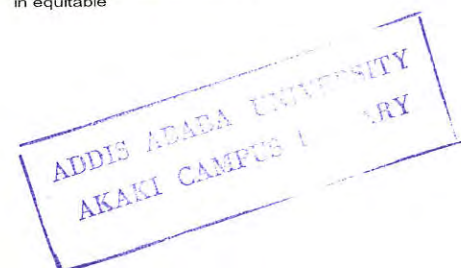
Salinity cause	Number	Percent
Valid	47	42.7
Water	13	11.8
Land	19	17.3
Farming practice	31	28.2
Total	110	100.0

Source survey (field interview) data

The other major challenge the farmers were complaining is the water use conditions in the up and down streams. As it was shown in the graph below, majority of the respondent said that it is inequitable. Water resource use inequality is one of the major socio ecological problems that could result in mass unrest and damages many development projects and programs and puts the environment under stresses.



Graph 3, Up and down stream water use condition (source–survey data)



4.5. Social and Institutional Conditions of Tibila Irrigation Based Development Project.

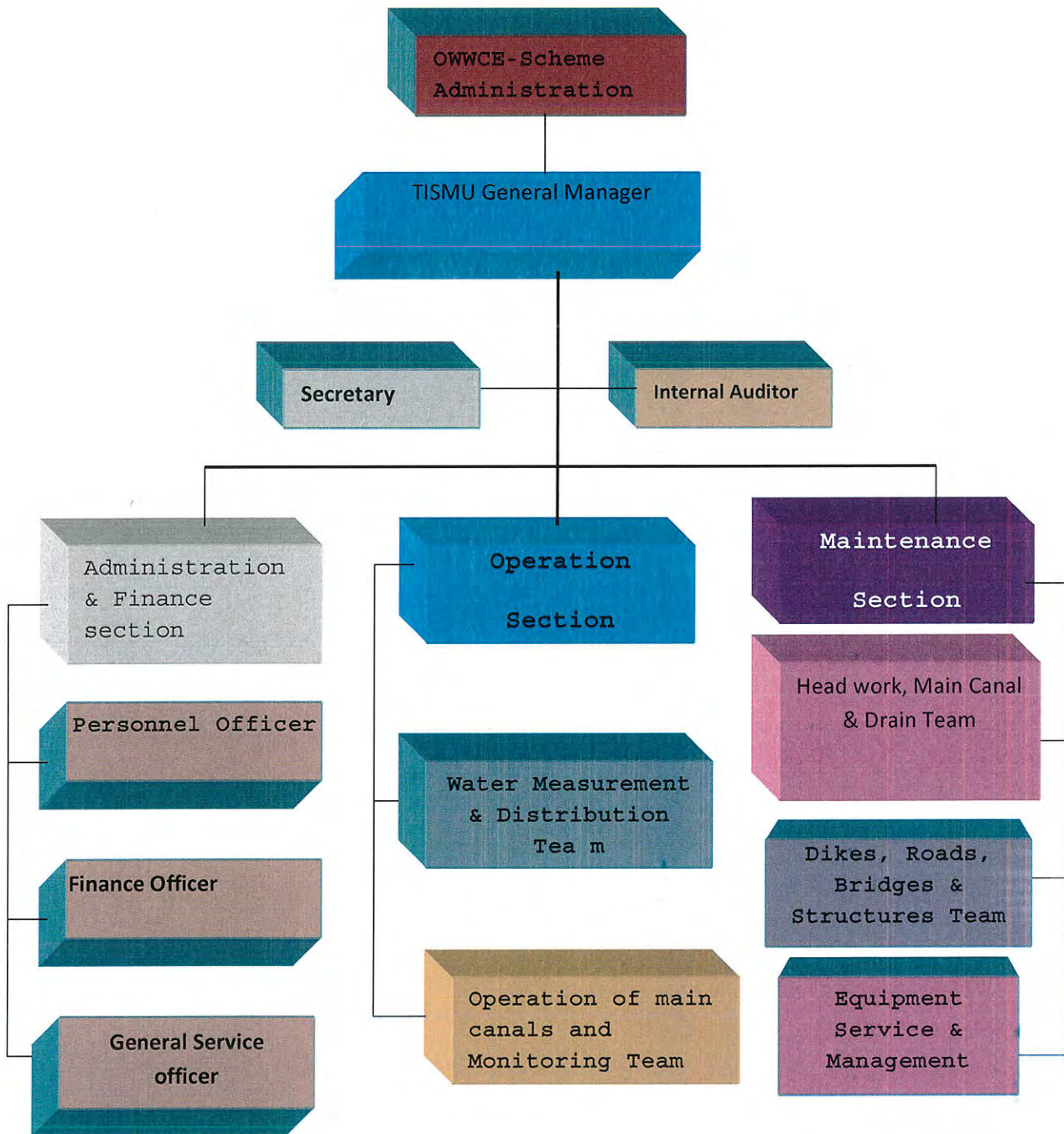
OWWDSE (2009) dictates that Tibila irrigation water management organization is structured and operated in a manner that suits the system. The management, operation and maintenance of Weir/Head work and Main system Infrastructure is the responsibility of the Government, as a result Tibila Irrigation Scheme Management Unit (TISMU) was established under the umbrella of Oromia water Works Construction Enterprise (OWWCE), which is mandated to construct, own and manage large-scale irrigation schemes. In any irrigation management organization, irrigation water distribution and maintenance of irrigation and drainage infrastructures (i.e., O&M) are clearly of central importance. As a result, in the proposed organizational structure of TISMU, the water management activities have been given emphasis as detailed below. The aim or the ultimate goal of TISMU can be stated as, to ensure enough and sustained supply of water to TIS and the safety of its structures, diversion weir, reservoir, main canal, main road, and main drain on behalf of OWWCE. To achieve the goal stated above, the TISMU will have the following major functions (OWWDSE, 2009)

- Distribute enough water according to the demands of the irrigation farms
- Control, register and report the amount of water flowing to the irrigation farms.
- Monitor the level of water available to ensure adequate water for irrigation and also to avoid excessive water releases that may cause damage to downstream developments, if any.
- Register water usage and collect water charges.
- Maintain headwork and Conveyance systems i.e. Irrigation and Drainage net work-consisting of:
 - ✓ Headwork
 - ✓ Primary canals
 - ✓ Secondary canals
 - ✓ Tertiary canals and
 - ✓ Main drain.
- Cross drainage structures across canals e.g. Aqueducts, Super passage, Bridge etc...
- Main Canal structures e.g. Head Regulators, Outlets etc.
- Service roads and inspection paths, along canal networks.

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- Protect the main canal from damaging or undesirable elements
- Technical assistance for the operation and maintenance of the quaternary systems and their improvements when needed.
- Assessment and establishment of water rate and Collecting of water fee.

Figure 4 Organizational Structures for TISMU, (Source: - OWWDSE, 2009.)



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The operation and maintenance of the head work, appurtenant works, infrastructures, on farm development and drainage system need knowledge, systematic approach, constant devotion to utilize the services successfully and sustain the scheme for a longer period of time. From the field survey and discussion with key informants, the understanding they have about operation and maintenance is very impressive. 29.1% of the sampled farmers replied that operation and maintenance can increase water availability, 48.2% said it can improve flow time and 17.3% replied water quality will be improved if Operation and maintenance is carried out properly. See the table 26.

Table 26, Responses of Farmers on operation and maintenance uses.

Uses of O&M	Number	Percent
Valid	6	5.5
increase water availability	32	29.1
improve flow time	53	48.2
improve water quality	19	17.3
Total	110	100.0

Source- survey data

The discussion and interview made with the farmers shows that even though they have good understanding with the importance of operation and maintenance, some of them face difficulties with the operation and maintenance, management, of certain structures. The tabular data presented below shows that 30% of the sampled house hold cannot operate or manage some infrastructures by themselves. It means they require qualified person to help them in infrastructures management. Therefore, capacity building and guide line on system operation and maintenance is very important.

Table 27 Infrastructures manageability by farmers (Source: - survey data)

Response	Number	Percent
yes	77	70.0
no	33	30.0
Total	110	100.0

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As it was stated in irrigation system operation and maintenance guideline, the most important conditions for irrigation scheme sustainability are:

- An adequately designed irrigation system;
- An appropriate organizational structure;
- The establishment of consistent and clearly-defined overall objectives and strategies;
- A well-designed management system (detailed management procedures, job descriptions, information and monitoring systems);
- Policies on staff recruitment, production and salaries which provide incentives for the attainment of project objectives;
- Adequate financial support for recurrent expenditure, either from government funds or from water charges paid to the project, or a combination of the two;
- Effective legal framework, for the enforcement of water distribution rules.

Based on the FGD discussant views and survey analysis shows that the strength of the WUA of TIBIDP is medium, majority of them reported that, the organizations have by laws, strategic and action plan, and good acceptances by farmers. See the tables 28, 29, 30 and 31.

Table 28 Organizational strength of TIBIDP

Response	Frequency	Percent
strong	22	20.0
medium	79	71.8
weak	9	8.2
Total	110	100.0

Table 30, Farmers response on existence of by laws

Response	Frequency	Percent
Valid	1	.9
yes	103	93.6
no	6	5.5
Total	110	100.0

Table 29 Strategic and action plan existence.

Response	Frequency	Percent
yes	103	93.6
no	7	6.4
Total	110	100.0

Table 31 Farmers acceptance of the WUA

acceptance	Frequency	Percent
high	46	41.8
medium	55	50.0
low	9	8.2
Total	110	100.0

Source -survey data.

The participation of women in the organization management of the scheme is low even if they accepted that women can play key role in the successes of the organization, due to

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cultural challenges that favors women to stay home, their number is very low or even none in certain kebeles.

For any organizational management sustainability, financial management and its control are important. The demand for water is increasing with the growing population pressure, economic development in many developing countries, and due to climatic variability's which results in fresh water scarcity worldwide. Thus, water valuation and demand management are inevitable issues to be applied in order that the water resources are efficiently and effectively used in equitable manner in order to bring socio-economic development in its multiple uses. Therefore, water pricing is one of the economic instruments/tools to be in practice to manage the demand as to bring the maximum economic benefit with the ecological system kept safe and protected while the scarcity and over use is optimized for the whole benefit and sustainable development. Moreover, mere methodologies, policies and guidelines have to be formulated in detail to be undertaken especially in developing countries like Ethiopia for getting prices right in the water sector. Tibila irrigation based development project financial management and project cost recoveries are as detailed below in (OWMEB, 2011) adopted from FAO 2003.

Service delivery - Cost and Accountability

- To cover the costs of providing the service without subsidy - ranging from O&M costs to full supply cost, including capital expenses and replacement costs.
- To fund adequate maintenance of infrastructure, preserving its productive function.
- To improve accountability of the water provider to users.

Demand Management, Water Allocation and Pollution Control

- To reduce excess demand
- To provide an incentive for the efficient use of scarce water resources.
- To allocate water to the highest priority uses.
- To provide incentives to improve water quality, reduce pollution levels or protect the environment.
- To encourage wise investment decisions by public and private organizations.

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Social objectives

- To create a benefit tax.
- To ensure equity of access to water or the benefits of its use

Social and institutional sustainability of any irrigation scheme plays remarkable role in the development and management of irrigation schemes. Tibila irrigation scheme management unit platform is appreciable and looks smart to fit the social cultural and local administrative setting but the internal functionality of the unit is not yet fully capacitated and empowered. Therefore, recruiting staffs, strengthening material and institutional capacities, are the next task to be accomplished as the focus group and key informants agree.

5. Conclusion and Recommendations

5.1. Conclusions

The study analyses the sustainability of Tibila irrigation based integrated development project (TIBIDP) against socio-economic, environmental and technical sustainability's. Tibila irrigation based integrated development project is initially designed to alleviate the food insecurity of the area and to enhance the socio economic development of the peoples. The importance the scheme in terms of socio-economic development is high. It improves the annual income of the beneficiaries, creates job opportunities for many peoples, and it also improves the land productivity and productions in the area. Productions of cash crops were also emerged in the area for the betterment of the society's living standard. Development interventions those are crucial for the peoples in the area such as access roads, bridges, extension services and facilities are developed due to the scheme. The development of these infrastructures together with the scheme development by itself is a big factor for the sustainability of the scheme operations. The rate of irrigation importance for the community is high. From a social perspective the working conditions, capacity building and community engagement is essential elements of farming and thus continuous capacity building on various issues and farming technology transfer are the key points to be addressed regularly. Achieving success in water conservation requires various levels of engagement and collaboration throughout the entire sector and its stakeholders. Throughout this collaboration, it appears that several solutions exist to improve the water use at the farm level, including good practices. In Tibila irrigation based integrated development project water management practices such as irrigation system management, water use efficiency and effectiveness, System operation and maintenance are at their infant stage and should be strengthened in both manpower and material capacity to attain the desired goal of the scheme on sustainable bases. Some aspects of environmental water sustainability looking at irrigation system management, leaks and logging prevention, salinity and sedimentation protection, watershed management, water quality monitoring, water conservation practices and the established comprehensive water management institutions at a farm level were essential elements as tried to be seen in the study. Accordingly, to bring environmental sustainability of the scheme, these variables of concern should be monitored regularly and kept safe. Institutional strength and capacity on effective and efficient water management practices on activities such as cost recovery collection and financial management, in gender mainstreaming and resource use optimization to maximize the

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scheme and environmental profit must be enhanced. Stake holder participation in the scheme over all activity will benefit all and in turn ensures the sustainability. Based on this the participation of all stake holders such as women, youths, non irrigators i.e. those living in anticipating area and river basin authorities and those other development enterprises in the area should have given an opportunity to participate in the management processes since water is a common pool resource in the basin.

5.2. Recommendations and policy implications

For the scheme, TIBIDP, to be sustainable, these Conditions are crucial:-

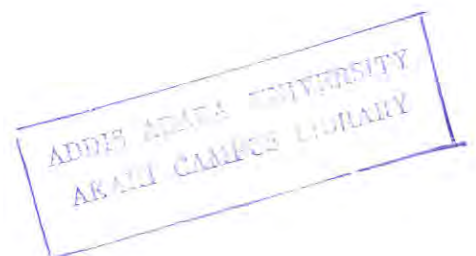
1. There should be Strong and continuous political backing for water management.
2. A clear role for the different stakeholders must be set.
3. Support for the empowerment of institutions at all levels (including water user associations and local governments).
4. The autonomy of the water user associations should clearly be defined.
5. The legal framework needed to accommodate the proposed changes in authority should be developed in depth.
6. Capacity building should be done continuously for the people governing the transferred system.
7. Simple and easily manageable, Functioning infrastructures should be adopted.
8. Success in recovering operation and maintenance costs should be maintained.
9. For the scheme to be sustainable, enough funds and budgets should be allocated to the water management component
10. Irrigation water management which requires a multi sector and socio-cultural setting must have proper attention equal to project or program development

And the following challenges were also identified during the field study and due attention must be given accordingly.

11. Lack of political support and incentives for scheme administration.
12. Resistance of public agencies and water users to accept the commands.
13. Insufficient resources for scheme administration.
14. Poor irrigation farming practices especially, low water conservation.

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15. Lack of proper involvement of water users.
16. Transfer of dilapidated or badly designed infrastructure that is dysfunctional and needs major improvements.
17. Environmental issues such as salinity, water use right or conflict with downstream dwellers, and non point source pollution from irrigation fields were not given much concern.
18. Unauthorized users such as brokers and excess land holding of certain farmers in the irrigation field were seen, these could result in exploitation, system monopolization, and conflicts. These will put the sustainability of the scheme under question.
19. Integration of other development programs such as marketing, storage and processing facilities, fishing, forage production, conservation practices, research and development works were very low or none and should be up raised as much as possible very soon.
20. Practices and dissemination of Mechanized farming technologies and methods would be good for the betterment of the society's life style.



References

- Aillery, M. (2002). *Irrigation management*. AREI.
- Bakker, M. R. (1999). *Multiple Uses of Water in Irrigated Areas, a case study from srilanka*. colombo: International Water Management Institute.
- Bhattarai, H. S. (2002). *Irrigation impacts on income inequality poverty alleviation: Policy issues and options for improved management of irrigation system*. Colombo Sirlanka: IWMI.
- David, T. (2002). Agricultural sustainability and intensive production practices. *Nature* , 1-2.
- Eduardo.A. (2009). Irrigation water management. *Chilean jar, agricultural research* , 16-25.
- Ersado, L. (2005). *Small- Scale Irrigation Dams, Agricultural Production and Health: Theory and Evidence from Ethiopial,.* World Bank Policy Research Working Paper 3494 . Washington,DC, USA: The World Bank.
- F acon M. (2007). *multiple uses of water*. sirlanka,colombo: IWMI.
- FAO. (1986). *Irrigation in Africa South of the Sahara*. FAO Investment Center.
- FAO. (1996). *Guidelines for planning irrigation and drainage investment projects, Technical paper 11*. Italy,Rome.
- FAO. (2000). *Irrigation Potential In Africa: basin Aproach*. Rome: FAO Land and Water Bulletin.
- FAO. (2003). *Farm Management for Asia: A Systems Approach, Department of Agricultural and Resource Economics*. Australia: University of New England.
- FAO. (2007). *Environmental Impacts of irrigation*. Rome.
- Hamdy.A. (2000). *Water use efficiency in irrigated agriculture: an analytical review in the mediteranean region*. Italy: Mediterranean agronomic Institute of Bari.
- Huppert, W. (1989). Governing Irrigation Service Delivery in Water Scarce Situations. In W. Huppert, *Governing Irrigation Service Delivery in Water Scarce Situations* (pp. 55-60.). . International Commission on Irrigation and Drainage, ICID .
- IWMI. (1991). *The turnover and self management of irrigation institutions in developing countries*. Colombo. Sri I:anka: IWMI.
- IWMI. (2001). *Irrigation against Rural Poverty: An Overview of Issues and Pro-Poor Intervention Strategies in. Asia*.
- IWMI. (2007a). *Importance of Irrigated Agriculture to the Ethiopian Economy*. IWMI.

SUSTAINABILITY OF TIBIDP

- IWMI. (2007b). *Water Resources and Irrigation Development in Ethiopia*. Colombo, Sri Lanka: International Water management institute.
- Kumar, R. a. (2003). Regional water management modelling for decision support in irrigated agriculture. *J. Irrig. Drain. Eng* , 129:432-439.
- Loucks, D. P. (2000). Sustainable Water Resources Management. *International Water Resources Association* , 3-10.
- Mollinga. (2003). *On the Water Front: Water Distribution, Technology and Agriculture Change in a South Indian Canal Irrigation System*. New Delhi: Orient Longman Private Limited.
- MOWR. (2001). *Ethiopian Water Sector Policy*. Addis Ababa.
- MoWR. (2002). *Water resource Developemnt Programme 2002-2016*. Addis Ababa: The Federal Democratic Republic of Ethiopia Ministry of Water Resource.
- OECD. (1999). *Environmental indicators for agriculture*. paris: OECD publisher.
- Ostrom, E. (1991). *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge U niversity press.
- OWMEB. (2002). *Five year irrigation developemnt plan of Oromia*. Finfinne, Oromia: OWMEB.
- OWWDSE. (2009). *Tibila irrigation based integrated development project appraisal document*. Addis Ababa, Ethiopia: OWRB.
- Partnership, G. W. (2000). *Towards Water Security: A Framework for Action*. Global Water Partnership.
- Schaible, G. D. (2006). *AREI Irrigation Water Management—A Workshop Summary*. USA.
- Selesh Bekele Awulachew, A. D., & Losiskandl, M. A. (2007). *Water resource and Irrigation Developemnt in Ethiopia*. *International Water Management Institute working paper 123*. Colombo: International Water Management Institute,.
- Sisay Belay (2011). *Community-based Irrigation Water Management System: the Case of Deder District, East Hararghe, Ethiopia*. Dire Dawa, Ethiopia.
- Stockle. (2003). *Environmental Impact of irrigation Review*. Washington: Washington state university.
- Tafesse Andargie (2007). *Socio-economic and institutional determinants of small-scale irrigation schemes utilization in bale zone, Oromia national regional state*. Hara maya university: un published Msc thesis.
- The World Bank. (2006). *Ethiopia: Managing Water Resources to Maximize Sustainable Growth, World Bank Water Resources Assistance Strategy for Ethiopia*. . Washington, DC.

SUSTAINABILITY OF TIBIDP

- UNESCO. (2009). *The United Nations World Water Development report 3. Water in a Changing World, UN water*. Washington DC.
- UNESCO. (2004). *World Water Assessment Program: National Water Development Report for Ethiopia*. Addis Ababa: United Nations Educational, Scientific and Cultural Organization, UNESCO.
- Uphoff. (1989). *Improving International Irrigation Management with Farmers Participation. Getting the Process Right, Studies in Water Policy and Management*. Boulder: West View Press.
- Wagnew. (2004). *Socio economic and environmental impact assessment of communitybased small-scale irrigation in the Upper Awash Basin. A case study of four community based irrigation schemes*. Addis Ababa : AAU, MSc thesis.
- Woldeab Teshome . (2003). *Irrigation Practices, State Intervention and Farmers Life-worlds in Drought Prone Tigray, Ethiopia (PhD Dissertation)*.
- Worldbank. (2007). *Growth and Productivity in Agriculture and agribusiness. Evaluate lessons from World Bank Group Experience*. Washington DC: World Bank.
- WorldBank. (2006). *Reengaging in Agricultural Water Management Challenges and Options*. Washington, DC 20433 USA: world bank.
- Ximing. (2001). *Sustainability Analysis for Irrigation Water Management: Concepts, Methodology, and Application to the Aral Sea Region*. Washington, D.C ,U.S.A: International Food Policy Research Institute.
- Yohannes Geleta . (2010). *large scale irrigation management and critical environmental concern*. AAU, Research thesis: un published.

Appendix

QUESTIONNAIRE

Addis Ababa University

Institute of developmental studies

Center for environmental studies

Research title: - Sustainability of Tibila Irrigation Based Integrated Development Project

The purpose of the study is to clarify the present state of the irrigation management with a focus on sustainability analysis via socio-economic contexts, environmental and management challenges to establish where problems have occurred and suggest possible options and strategies for future improvement of irrigation planning and management, particularly in the study area and the country in general.

DEAR RESPONDENT!

The result of this study, which includes suggestions of the respondents, will help different stakeholders and policy makers to take appropriate measures to further improve the irrigation management. Therefore, you are kindly requested to provide with genuine responses.

Thank you for your cooperation.

Lemma Adane.

A. General

1. Research Site: Districts..... PA/village.....
2. Household Head:
 - a) Name
 - b) Sex: 1) male 2) female 3) Age :.....(years)
3. Educational status
4. How many house hold members do you have... ..

B. Resource availability and its potential utilization

1. How many hectares of irrigation land you have?
2. What type of crops are you growing in your irrigation land? 1, Fruits, 2, Vegetables 3, Food crops 4, Cash crop 5, any other specify _____

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3. How do you keep or improve your farm land fertility? 1, Soil mulching, 2, Artificial fertilizer, 3, Land-fallowing, 4, other specify-----
4. What kind of tools and farming methods are you using?
 1. Traditional and man power
 2. Oxen and man power
 3. Improved or mechanized method
 4. Other, specify _____

C. Sustainability

I. Economic factors

1. Can you rate the importance of irrigation to you? 1. High 2. medium 3. Low
2. Is your life changed after you start to use irrigation? 1, Yes 2, No
3. How many birr/s can you earn from your irrigation annually approximately? -----
4. What achievements you got after you began irrigation? -----
5. Can you afford to pay for Project cost recovery, Operation & maintenances and Water service fees? 1. Yes 2. No
6. What is the mode of payment? 1. Land size 2. Product Output size 3. equally shared among the beneficiaries 4. Amount of water used
7. How many extra persons are working on your irrigation field after you began irrigation?
8. Is the cost of labor increased? 1. Yes 2. No 3. No difference
9. Is your overall annual crop production increased? 1. Yes 2. No
10. How many quintals per hectare can you earn from irrigation? (Give on each crop)

Crop type	Amount
1 -----	1 -----
2 -----	2-----
3 -----	3-----
4 -----	4-----
11. Do the proposed cropping patterns improve productivity? 1. Yes 2. No
12. Do you have market problem for your product? 1. Yes 2. No
13. If yes what are these? 1, Market distortion/trade system debagging 2, Information gap or lack of information 3, Lack of Access or distance 4, Lack of organizational arrangement for market
13. What is the average price of each crop approximately per quintal?

Crop type	Price
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
14. Do your irrigation farm lands are sufficient to satisfy your family basic needs? 1. Yes 2. No
15. If no, what other sources do you have? _____

II. Technical factors

1. Do you think the Irrigation water is enough for the project? 1. Yes 2. No
2. Is there water shortage for your plot? 1. Yes 2. No
3. If your answer for the above question is yes what do you think the reason?
 1. No right water acquisition or allocation system
 2. The efficiency of the system is poor
 3. Water is not effectively distributed
 4. Management is poor
 5. System operation is not well known by farmers
 6. Water conveyance system is not functioning well

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4. Is system distribution design hinders equitable use? 1. Yes 2. No
5. What is the mode of water application? 1. Furrow 2. Flooding 3. Other, specify -----
6. Do you feel you share equal water with every user in the scheme? 1. Yes, 2. No
7. If no, what do you think is the reason for the inequality? 1, Structures dysfunction, 2, Topography 3, Financial power (ability to pay) 4, System Design problem 5, Management problems, 6, Nearness to the main water canal
8. Can you maintain your system regularly? 1. Yes 2. No
9. Is system operation and maintenance help to improve productivity? 1. Yes 2. No
10. If yes how?
 1. Increase water availability/ Improve water loss 2.Improve flow time 3.Improve water quality
11. How do you think water quality and quantity affect productivity?
 1. More quantity and quality can water more area 2. More quantity can be given more frequently for crop, 3. No relation 4.1&2
12. Is there soil erosion or sedimentation problem in your farm? 1. Yes 2. No
13. Do have irrigation scheduling (irrigating in turn and on time of need)? 1. Yes 2. No
14. If yes how you practice scheduling and farming practice?
 1. I will use defined time interval 2. I will water when there is water availability
 3. I will use crop indicator 4.I will use soil indicator 4.i don't know
15. How do you improve on farm water loss?
 1. Soil mulching 2. Night - irrigation, 3. Land leveling and improved farming 4. Other (specify) -----
16. Are all irrigation infrastructures manageable at your level? 1. Yes 2. No
17. How the irrigation system management in general looks like? 1, Good 2, Medium 3, Poor
18. What are the major challenges you face with the irrigation infrastructures? 1. Gates are not properly working 2. Canals are not functioning well 3. No proper division and distribution system 4. Other specify-----
19. Which structures are functions well and properly suits you? (Canals, gates, divisions, or others verify)

III .Social and institutional factors

1. Have you had any conflict with somebody else on water? 1. Yes 2.No
2. If your answer is yes with whom?
 1. among the beneficiaries, 2, With D/s users 3, With U/s users 4, with 1, 2 &3,
3. Why do you think is the water is the cause for conflict? Because of; 1, Scarcity of water, 2, Water Management problem, 3, Water theft, 4, Others, specify
4. If yes, please mention all causes you remember Cause;
 1. _____ 3. _____
 2. _____ 4. _____
5. Is there any water organization in your irrigation area? 1. Yes 2. No
6. If yes, what is it? 1, WUA 2, WUC 3, WUG 4, others, specify ____
7. What structural organization it has?
 - 1, Chair man, 2, Accountants, 3, Writer and record keeper, 4, executive members, 5, All
8. Does your water organization have bylaws? 1. Yes 2. No
9. Does your organization have legal back ground? 1. Yes 2. No
10. How is your by laws enforcements? 1, Strong 2, Medium 3, Weak
11. Do your organization has strategic and action plan? 1. Yes 2. No
12. Is there any external consulting and evaluating body for your organization? 1. Yes 2. No
13. Is there illegal practice? (E.g. Using without turn, etc)? 1, Yes, 2, No

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14. If your answer is yes, is there punishment by the water organization? 1. Yes, 2. No
 15. Do you think the punishment is enough? 1. Yes 2. No
 16. Is there incentive for good work and behavior? 1. Yes 2. No

 17. How do you evaluate your water organization? 1, Strong 2, Medium, 3, Weak
 18. Do your organization has financial and data management system? 1. Yes 2. No
 19. is your water user organization participating women and youths? 1. Yes 2. No
 20. What are the main functions of your organization? -----
 21. Is there cultural and traditional power relation in the community for water management?
1 yes 2. No
 22. is cultural practice and community tradition affects the irrigation system? 1. Yes 2. No,
 23. If yes, how? _____
 24. How much is the acceptance of the organization by the farmers when compared to the traditional one? 1. High, 2. Indifferent,3. Low
 25. Are you willing to participate in any planned activities of your organization? 1. Yes 2. No
- IV. Environmental factors**
1. Is the irrigation water is enough for the whole farm? 1. Yes 2. No
 2. If no, why you think it is scarce/short? 1, Population increase 2, Irrigation land expansion, 3, Water use or need expansion, 4, Water scarcity in the basin 5, Water losses at different level
 3. is there water logging in your farm? 1. Yes 2.no
 4. If water is short, what do you think the cause for shortage of water?
1, Scarcity 2, Management, 3, Accessibility, 4, Climate change 5, other, specify----
 5. What is the quality of water for irrigation? 1, Good 2, Medium, 3, Bad
 6. Do you face any salinity problem so far? 1. Yes 2. No
 7. If there is what you do think the reason is? 1. Water 2. Land 3.Farming practice (fertilizer and others)
 8. If yes, what damages do they cause in the scheme? 1, Product loss 2, Crop damage 3, Soil damage4.all
 9. What agronomic measures are you taking so far to avoid salinity? 1, Leaching, 2, Deficit irrigation, 3, Land fallowing 4, others specify
 10. Does your irrigation system affect flora and fauna of the area? 1. Yes 2. No
 11. If your answer is yes, how? _____
 12. Do you have soil erosion and sedimentation problems in your plot area? 1. Yes 2. No
 13. If your answer yes, why? Because 1, Irrigation water management is poor, 2, Application system (furrow or flooding problems), 3, Structures problems, 4, others/Specify _____
 14. Do you have the problems of weeds in the irrigation area? 1. Yes 2. No
 15. Are there any damages in the up or down stream due to irrigation system? 1. Yes 2. No, if yes, what are the damages? Verify _____
 16. is there water shed management in the vicinity of the scheme? 1. Yes, 2. No
 17. If yes, what improvement it has brought for the scheme?

2. Checklist for Group Discussion (with concerned group), FGD.

- Organization, management performance and weaknesses of WUAs committee
- Water management in the irrigation systems: Water allocation and distribution
- Major problems in water management or principal areas of users' complaints.
- Bylaws and enforcement characteristics
- Supports given from the local Irrigation Office and local governance
- Conflict and conflict management in the irrigation systems
- Land tenure and water rights in the irrigation systems
- Support services; Credit, input (seed) and extension
- Technical problems of the irrigation schemes
- Socioeconomic viability of the irrigation intervention: Compatibility of irrigation with the farming system/socioeconomic environment (market, family labor allocation and choice of crops, etc. What do you think is the benefit of Tibila irrigation project?
- What do you think is the limitation of the project?
- Farmers' perception about benefits of irrigation and its sustainability
- The major constraints of irrigation farming the irrigation systems
- Background of irrigation development in the area
- Stakeholders, their expected roles, linkage, performance and constraints
- Qualities of water.

Key informants Interview guides

- *Physical setting of the Irrigation system and water shade management practice.*
- *Socio-economic profile of the area*
- *Irrigation Development and its institutional in the area*
- *Organization of users for self management: organization, performance and constrains.*
- *Environmental problems, water logging, salinity, wet land etc.*
- *Water management in the irrigation systems*
- *Major management and sustainability constraints*
- *Institutional capacity the irrigation agency: organization, capacity and effects of institutional instability*
- *Gender and equity issues.*
- *Policies, strategies and future action plans for LSI development.*
- *Service provision for irrigation: credit, input and extension*
- *Performance of WUAs in managing conflict*
- *Supporting activities of the irrigation desk to WUAs in irrigation management*
- *Major problems in the irrigation systems as they see them.*
- *Available technologies that work under irrigation and On-going research on irrigation?*
- *Benefits of irrigation*