

**The Federal Democratic Republic of  
Ethiopia Regional State of Tigray Bureau  
of Water Resource**

**A Partial Environmental and Social Impact  
Assessment Study Report For:  
Misrar-Teli Irrigation Project**

**(Tigray, South East Zone, Enderta wereda)**

**Final Report**

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## LIST OF ABBREVIATIONS

ARDO	Agriculture and Rural Development Office
asl	above sea level
BoANR	Bureau of Agriculture and Natural Resources
BoFED	Bureau of Finance and Economic Development
CA	Command Area
ESIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact assessment
EMP	Environmental Management Plan
EPA	National Environmental Protection Authority
EPE	Environmental Policy of Ethiopia
EPLAUA	Environmental Protection, Land Administration & Use Authority
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Production
ha	hectare
IEE	Initial environmental evaluation
km	kilometre
MoARD	Ministry of Agriculture and Rural Development
MoWR	Ministry of Water Resources
m <sup>3</sup> /sec	Metre cube per second
m	Metre
NRS	National Regional State
PAP	Project Affected People
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PP	Project Proponent/Project Owner
REA	Regional Environmental Agency
SEU	Sectoral Environmental Unit
STD	Sexually Transmitted Disease
HO	Health Office
WOA	Woreda Agriculture and Rural Development Office
WWSDSE	Water Works Study Design and Supervision Enterprise
WOFED	Woreda Office of Finance and Economic Development
WOA	Woreda Office of Agriculture

## I. EXECUTIVE SUMMARY

Tigray is naturally endowed with rich water and land resources that can be utilized for irrigated agriculture. But it has been faced with recurrent droughts which are caused by the erratic nature and high spatial and temporal variability as well as low total amount of rainfall. Back ward agricultural practices also contributed to low productivity and accelerated land degradation, which aggravates the impacts of the droughts. To reverse the situation, the Federal Government and the Regional Government of Tigray together with nongovernmental organizations like **IFAD** initiated irrigation development strategy for the main objective of attaining food security at a farmer house hold level and bring about an overall socio-economic development in the region. The nucleus of this development strategy is to utilize the available land and water resources effectively and efficiently.

For this reason, Misrar-Teli small scale irrigation project is one of such potential areas found in Tigray National Regional State, South East Zone, Enderta woreda, along the middle course of Misrar-Teli River. The irrigation project has been identified to utilize the surface water from the river for surface irrigation using diversion structure. From the potential total command area, gross irrigable areas of **50 ha** have been identified in Mahbere Genet Tabya/Kebele at a local known by Tsilwe. The irrigation scheme is planned to produce mainly cereal and horticultural production and study is being undertaken. In carrying out the study of the project, due emphasis is given to ensure that the project should be technically feasible, economically viable, socially acceptable and environmentally sound.

It's obvious that an irrigation can bring a multi socio-economic and ecological benefits to the project targeted area however if the the residual social and environmental adverse impact is get in to account the project feasibility is not such guaranteed. Due to this a partial Environmental and Social Impact Assessment (ESIA) is an integral part of the feasibility study and its main objective is to ensure that this irrigation project not only brings the intended economic development but also mitigates the likely negative adverse environmental and social impacts of implementing the project project. This ESIA study is based on review of relevant previous studies; policy and guideline documents, donor's eligibility criteria, primary data collected through field survey and onsite assessment, secondary data gathered from various offices at, woreda and local levels and consultations made with key stakeholders, project affected people (PAPs) and the local community. Thus, formal meetings and focus group discussion has carried out at kebele level and with wereda concerned officials to assess development potentials and constraints relevant to the project area; existing potential environmental and social impacts and mitigation measures related to the proposed irrigation development was analyzed. Generally, the results of consultations made with concerned stakeholders, groups and community members revealed that they accepted the proposed irrigation project and expressed their willingness to support and contribute for the successful implementation of the project.

The alternative scenario of the project considered on their importance to site selection and fair utilization of irrigation water of the project. The results have revealed that there is a pressing need to increase agricultural production in order to produce sufficient food for the rapidly growing population and to improve the livelihood of the people particularly the small holder peasant farmers in the project area.

Implementations of the proposed irrigation project have several potential



benefits to the region in general, and to the local communities in particular. Major potential environmental and socio economic benefits and their significance are described below:

- ❖ Improved food security and nutritional status: - through increased and varied agricultural production using reliable irrigation water.
- ❖ Creation of job opportunities and reduction of poverty: - Implementation of the project will provide substantial job opportunities for the unemployed people and those engaged in rain-fed agriculture during the idle periods that will support their livelihood and reduce poverty.
- ❖ Improved physical and social Infrastructure: - improvements in physical and social infrastructure as the implementation of the irrigation project shall include development of additional health facilities, drinking water supplies, and access roads.
- ❖ Increased efficient use of water and land resources.
- ❖ Bring new irrigation technologies and experience to the locality
- ❖ Served as a base for small scale agro-industrial development: - as a source of raw material, are among the potential positive effects.
- ❖ Provide emergency response during drought and weather fluctuation events
- ❖ Enhance small scale fishery activities and fish development
- ❖ Stabilize micro climate at local level

On the other hand, the construction and operation of the project will result in several adverse\negative impacts. The major adverse impacts are related to construction and operation and land preparation of the irrigation command area.

**Potential negative impacts and their significance include:**

- Land degradation mainly due to loss of natural vegetation; - reservoir and command area and other project activities that are likely to affect the natural vegetation.
- High prevalence of malaria and other water related diseases as water lodging may occur in the process of irrigation water management.

- Chanel sedimentation due to catchment's degradation and soil erosion.
- Excessive use of agrochemicals (fertilizers and pesticides) due to the irrigable agriculture.
- Public and Environmental Safety Issues.
- Drainage and water logging when improper irrigation is practiced.
- Impacts due to exploitation of construction materials
- Irrigation water quality concern
- Affect Downstream users both on quality and quantity of irrigation water

**Major mitigation measures or enhancement actions include:**

- Protection and rehabilitation of the upper catchments and river banks,
- Integrated fodder development in catchment rehabilitation and irrigation development works to improve animal feed\ fodder availability.
- Mitigation of drainage and water lodging problems by implementing proper irrigation management and drainage systems.
- Establishment of an efficient water application/management system that delivers only necessary quantities of water to irrigation fields to prevent adverse soil modification like water-logging, and creation of mosquito and snail breeding sites;
- Application of proper handling and use of agro-chemicals according to accepted guidelines;
- Proper use of fertilizers and environmentally friendly chemicals and biological control measures against pests and diseases;
- Along with the introduction of irrigation, the capacity of the irrigation sector and the community has to be empowered on irrigation/ water management through HRD, Training, delivery of inputs/equipments, etc.
- Restoration of areas affected for temporary uses after project completion, such as construction material excavations, camps, borrow sites, etc.
- Catchment conservation strategy : since reservoir and canal sedimentation

due to catchment's degradation and soil erosion as hill sides are being used for cultivation and have an over grazing incident.

- Establishment of a strong environmental management, vector, and STD control programme to control the transmission of water related, vector-borne and STD diseases including malaria.
- Establishment of a monitoring program for checking the critical parameters like water quality, relevant soil characteristics, groundwater level, water-logging, and disease vector breeding places
- The role of the key stakeholders including the Regional Bureau of Agriculture, Water Resources Bureau, Woreda and Kebele Administrations, Agriculture Offices and Health Offices to implement the mitigation measures specified in the ESMP and other necessary mitigation actions also clearly indicated;

**Key ESIA findings:**

- This irrigation project comprises a gross irrigable area of 50 ha. With the major irrigation based production for markets and consumption, enhance food security and provide raw material for expanding small scale agro-industry and could lay its own role for the GTP at local, regional, and national level in improving the living standards of the people.
- There are also vast opportunities for small scale fishery development in the reservoir to generate nutritional variety and additional income.
- Public consultations assured that the project is accepted by the people of the project area and concerned stake holders for its future and present development opportunities provided with emphasis on sustainability of the project and fair benefit among project target households' for irrigation water utilization and management .
- For the overall project sustainability the role and cooperation of different stakeholders during various project phases to enhance and typical impact management is very crucial.

- Generally speaking ,there is no significantly unalleviated impact that inhibits the implementation of the project hence, the project is found to be economically, socially and environmentally eligible with considering the proposed enhancement and mitigation actions to be more compatible with regional , national , international and donor's eligibility parameter.
- The proposed mitigation measures shall be properly implemented at the right time, with Total estimated Environmental mitigation cost of **814,000.00** Birr and necessary follow up of their effectiveness should be made through well planned monitoring program with the estimated cost of **90,000.00** Birr and a total of Birr **904,000.00** for the consecutive planed years by concerned stakeholders to have minimal and acceptable residual environmental and social impacts and enhance the potential benefits. In general, the design of the proposed irrigation project showed that the cost of the project over weights its benefits. Therefore, in carrying out the final study, the project is found to be socially acceptable, economically viable, and environmentally sustainable.

## 1. INTRODUCTION

### 1.1 Background

There is a reasonably well-developed position by the wider community that the net benefit from irrigation expected towards production outcomes especially at the expense of freshwater ecosystems, and that irrigation practice needs to achieve a better balance between water use for production and environmental protection.

The irrigation industry also appreciates that environmental issues need to be better managed to enable irrigation to be a sustainable practice into the future, and wants to achieve a more balanced public perspective of irrigation. A more pro-active and transparent approach to environmental management by irrigation schemes and provision of information may help to demonstrate that efforts are being made to reduce and better manage negative effects.

Studies revealed that land degradation, erratic and shortage of rainfall have been among the major challenges of the the agriculture sectore both at country, the region and the project target wereda (Enderta). As a result, the farming community has suffered from recurrent drought and inadequate seasonal agricultural production. Though, the woreda is endowed with vast potential of water and vast plain and gently sloped lands that could be used for irrigation but still agriculture remains at its subsistence level.

For this, the region has decided to efficiently use its water and land resources. The Misrar-Teli irrigation project is one of the potential development endeavors of the region with the possibility of cultivating the vast plain fields of wereda which lain at the most upper catchment south east of Tekeze basin irrigate on 50 ha of farm land by constructing a diversion.

The project site is found Enderta woreda is found in Tigray Region, South East Zone. Typically the project target kebele is known by Mahbere- Genet which the project directly located at a village Tsilwe while the scheme is also termed as Misrar-Teli having an absolute geographical location of Northern 545155.03 and Eastern 1500099.06 UTM.

Based on the national and regional ESIA legal requirement and initial environmental assessment early carried out by the assigned consultancy (TWWSDSE) the project categorized under schedule-II (B) projects that should pass through partial ESIA/ESMP study, since the project have less environmental and social impacts which can be reversible having less frequency geographical coverage and less significance magnitude. accordingly to respect not only the economic viability but also to maintain the environmental and social feasibility of the project The project owner (TWRB) and the donor IFAD has assigned Tigray Water Works Design and Supervision Enterprise to conduct a the environmental feasibility study and prepare a detailed design for the mentioned irrigation project.

Accordingly, a partial Environmental and Social Impact Assessment study is part of the consultancy service and this report presents the findings of the environmental and social impact analysis and recommendations for consideration during the design, construction, and operation phases of the project.

To carry out the final partial ESIA study a team of experts that consists of multi disciplinary professionals (Environmentalist, Socio-economist, hydrologist, geologist, Watershed Expert and Agronomist) were participated.

Based on the ESIA study findings, realization of the proposed project is expected to result in a number of positive socio-economic impacts including increase production and productivity to alleviate poverty and improve the livelihood of the community, provision of employment opportunities, improved social and

physical infrastructure and create opportunities for small scale agro industrial development, and related benefits at local and national level.

On the contrary, it will result in less significance adverse environmental and social impacts including: degradation of bush land, soil erosion, put impact on downstream users and public health concern from water related diseases, drainage problems. Provided that appropriate compensational, environmental flow and applying public health emergency measure can solve the public concern, other negative impacts can be reduced to acceptable levels through integration of environmental mitigation measures in the design or planning and implementation phases of the project. Therefore, it can be concluded that there will be no severe or immitigable impacts that will prevent the implementation of this irrigation project. Regarding social acceptability, the proposed irrigation project is highly accepted by the population in the command area and stakeholders consulted at woreda and local community and PAPs levels.

In order to have minimal and acceptable residual environmental and social impacts, and enhance the potential benefits, it is recommended that the proposed mitigation measures should properly implemented at the right time, and necessary follow up of their effectiveness is made through well planned monitoring programs in particular, the following mitigation measures or actions shall be given due attention.

Thus, to bring the overall environmental and social sustainability of the project identified stakeholders and the project owner should give emphasis to the assigned responsibilities and the compulsory budget for implementation and monitoring purpose shall be timely allocated.

## **1.2 Rationality for ESIA ( Purpose of the study)**

The purpose of this study is to identify the major adverse impact using the screening results for eligibility and for the overall sustainability of the irrigation development project. Accordingly there are some environmental and social effects to be harmonizing and enhanced throughout the project cycle due to this a partial ESIA become compulsory to handover such complaint of this irrigation project. The decision for such scope of environmental, social and climate vulnerability assessment is highly depend on the preliminary study out comes and the donor (IFAD) eligibility criteria requirements.

## **1.3 Objective of the study**

The main objective of this partial ESIA study is to ensure the overall environmental and social sustainability and climate resilience of the proposed Misrar Teli small-scull surface irrigation Project. It is intended to improve the overall environmental and social performance of the project by obviating or keeping the negative impacts to the minimum through integration of appropriate mitigation and enhancement measures in the project design, implementation, and operation.

Having the general objective in mind the project have also conducted by emphasizing on the following detailed objectives

- To describe and map the environmental baseline profile of the study area
- To identify, define, and assess the potential effects of the Project on Valued Ecosystem Components and socio economic settings
- To assess a public view towards the project and its acceptability
- To examine the overall eligibility condition of the proposed project
- To assess the level of environmental study of the project
- To ensure environmental considerations are explicitly addressed and incorporated into the planning, design, and decision-making processes
- To examine climate resilience performance



- To identifying the major environmental and social impacts and so as to recommend alternatives, enhancement and mitigation measures.
- Considering all the objectives, to design a project follow-up and monitoring program that contains plans to prevent and mitigate potentially adverse environmental and social effects of the Project
- To identify the stakeholder responsibility and cooperation

#### **1.4 Scope of the study**

There are different possible stages of environmental study required under such irrigation project, depending upon the potential adverse environmental and social effects of a project and/or stakeholder issues. Since all projects subject to pass through an initial environmental and social study an IEE has early carried out to identify the scope of the study by which type of an environmental assessment study should passed.

Based on the IEE findings, Project eligibility condition, impact geographical coverage major impact frequency, significance, and magnitude are identified thus; the project is categorized under **schedule-II (B)** projects that should pass through partial ESIA/ESMP study.

since the project have less environmental and social impacts which can be reversible having less frequency, geographical coverage and less significance magnitude the scope of environmental assessment of this project is assigned to be **partial ESIA**.

Similarly, the geographical limit of this project is typically laid on the command area main canal alignment of the proposed site, down streams, neighboring settlement areas, and some affected cultivated land and to some extent peripheral area of the delineated project watershed have identified as the major **impact zone** of the project.

## **1.4 Approaches and Methods of the study**

### **1.4.1 Data source**

In order to submit credible document it should have to assumed and exploited and review relevant data from different area of concern, project site and affected community, concerned officials and sectors have participate and consulted. Accordingly, during this initial environmental examination these methods were utilized as primarily source of the assessment:

- ✓ site observation of the project area
- ✓ screening of impact zone ( project command area)
- ✓ review secondary data /base line data/ of study area from each rural local administration offices
- ✓ Irrigation water quality investigation
- ✓ adopt views and perceptions of local experts like DA and others
- ✓ Informal interview with project affected community and local governmental officials
- ✓ review and adopt secondary data from relevant wereda and kebele sectoral offices
- ✓ International, national and regional environmental and legal based documents and relevant materials have/will adopt and reviewed.

### **1.4.2 Review of relevant documents**

Relevant Policies, legislation, and guidelines pertinent to environmental protection were gathered and reviewed for assessing the relevant environmental policies, laws and regulations related to environmental protection matters in general and the expected environmental impacts of the proposed development in particular.

Project donor environmental policies and eligibility criteria also reviewed

### **1.4.3 Review of previous studies**

Previous study report of the Tigray Water Resources Bureau and other relevant document studies of the woreda and of the project area were obtained and reviewed in order to obtain important data.

### **1.4.4 Public and stakeholders consultations**

Towards the proposed project people were consulted in the project Tabias of command area, woreda and Tabia Administration; and community leaders as well as different offices and relevant stakeholders were consulted about different issues concerning the project area.

The objective of public and others consultation were to:

- Inform the key stakeholders and the local community about the proposed irrigation project and their involvement.
- Gain ideas and information regarding the present development, Social and environmental problems of the project area.
- Collect information and opinion about possible environmental issues impacts related to the design, implementation and operation of the project
- Suggested solutions (game ideas) on what should be done to avoid, minimize or Offset existing major environmental problems that may occur with implementation and operation of the project, as well as attitude toward the project were investigated

### **Public Attitude and acceptability of Project**

All the consulted groups (officials, experts, individuals, and representatives of the local community, etc.) accepted the proposed surface irrigation project and expressed their willingness to support or contribute for successful implementation of the project. This is based on the assumption that the project would bring significant economic and social benefits to the region and local community, and that the potential negative effects would be avoided, reduced, or offset to acceptable levels. Among the issues indicated to be given highest

priority or utmost consideration include impacts on excluding previous traditional irrigation system users, damage on certain permanent fruit root tress through main canal alignment crossing, sustainability of the project and interruption of downstream users.

#### **1.4.5 Data Analysis and Interpretation**

The data and information collated from all the aforementioned sources (existing documentation review, secondary and primary data collection, stakeholders and public consultations and water quality measurements) were compiled and evaluated to describe the baseline environmental conditions of the project area, and to identify the possible positive and negative environmental impacts of the proposed project. Based on the existing environmental settings of the project impact areas and the expected project implementation activities, potential environmental impacts were identified and their expected significance is determined.

Then, appropriate mitigation measures and management plan for their implementation were recommended for the significant adverse impacts. Furthermore, a monitoring program was proposed to ensure the proper implementation and effectiveness of the mitigation actions, and to detect the actual effects of the project implementation activities.

#### **1.4.6 Materials utilized**

To carried out this partial environmental and social impact assessment a number of materials was utilized in order to facilitate and make credible the study process accordingly these materials has employed:

- Eligibility criteria checklist of the donor (IFAD)
- Impact Screening matrix model
- EC meter for irrigation water quality investigation
- Digital camera

- Hand GPS
- Administrative map of project kebele
- Global mapper and GIS software

#### **1.4.7 Major study limitations**

During the study and assessment process of this environmental and social evaluation study report preparation a numbers of challenges was faced , while among them the following remain the most critical which are:

- Incompatible schedule
- Inadequate time for final ESIA report preparation and submission
- Absence of some secondary data access

#### **1.4.8 Assumptions and Gap in Knowledge**

Although environmental policies and sectoral policies have been formulated and adopted, and environmental laws that would enable to reach the objectives set by the policies have been formulated and enacted also different national and regional institutes responsible to implement these policies are established still there are several obstacles and gap in knowledge in implementing the policies and laws. Similarly as this ESIA study to the proposed irrigation project indicated there could be different gaps and constraints to take action to the important findings of this study.

These obstacles or constraints include the following

- Limited capacity in the existing environmental protection institutions/ organs, especially at regional, wereda and kebele level
- Shortage of trained manpower and financial resources,
- Misconception of ESIA as an obstacle to development rather than a planning and management tool for sustainable development,
- Lack of reliable baseline data, and poor data retrieval and management system,

- Insufficient involvement of the public and stakeholders in ESIA process and implementation of the environmental management plan, and
- Poor implementation of ESIA recommendations/ mitigation plan, monitoring and follow up activities.
- Denial of project owner and responsible institute to allocate environmental management and monitoring budget and manpower.
- Inefficient monitoring relevant stakeholders

Therefore in order to effectively and sustainability implement basic findings of this study the following assumption should be taken n to account throughout the project life cycle.

## **2 ENVIRONMENTAL POLICY, STRATEGY, LEGISLATIONS AND ADMINISTRATIVE**

### **2.1 The Constitution of Ethiopia**

The Constitution of the Federal Democratic Republic of Ethiopia (FDRE), which was adopted in August 1995, has several provisions, which have direct policy, legal and institutional relevance for the appropriate implementation of environmental protection and rehabilitation action plans to avoid, mitigate, or compensate the adverse effects of development actions including agricultural development projects. The concepts of sustainable development and environment rights are entrenched in the rights of the people of Ethiopia through Articles 43 and 44, which state among others the right to development and the right to live in a clean and healthy environment.

Article 44 provides that all persons have the right to a clean healthy environment and further emphasizes that the pollutant shall pay in violating the basic right. Article 92 states that all Ethiopians shall live in clean and healthy environment; no damage or destruction happened to those basic environmental rights. People have the right to full consultation and the community has the right to express its views in the planning and implementation of environment policies and deals with the projects that directly affect them. The Government and citizens shall have the duty to protect the environment and mitigate the affected parts.

### **2.2 Policies and Strategies related to the study**

#### **2.2.1 Environmental Policy of Ethiopia**

The Environmental Policy of Ethiopia (EPE) was issued in April 1997. The EPE supports Constitutional Rights through its guiding principles. The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians, to promote sustainable social and economic development through sound management and use of natural, human-made and cultural resources and their

environment as a whole, so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. The policy seeks to ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities, and to raise public awareness and promote understanding of the essential linkage between environment and development. The policy establishes the Environmental Protection Authority (EPA) to harmonize Sectoral Development Plans and to implement an environmental management program for the Country. It also imparts political and popular support to the sustainable use of natural, human-made, and cultural resources at the federal, regional, zonal, Woreda and community levels.

### **2.2.2 Policies on Land Tenure, Expropriation and Compensation**

The constitution of the FDRE states that the right to ownership of rural and urban land, as well as all natural resources. Land is the property of the state/public and does not require compensation. The Constitution gives every person the ownership right for the property he has invested on the land, and in this regard article 40 (7) states that every Ethiopian shall have the full right to the immovable property he builds and to the permanent improvements he brings about on the land by his labour or capital. If the land that is owned by an individual is expropriated by the Government for public use, the person is entitled for compensation. In this regard, article 44 (2) of the Constitution states that all persons who have been displaced or whose livelihoods have been adversely affected as a result of state programs have the right to commensurate monetary or alternative means of compensation, including relocation with adequate state assistance.

### **2.2.3 Sectoral Policies**

The Government of Ethiopia has issued several sectoral policies, including the following:



**Water Resource Policy**

The Ministry of Water Resources formulated the Federal Water Resource Policy in 1998 for a comprehensive and integrated water resource management. The overall goal of the water resources policy is to enhance and promote all national efforts towards the efficient and optimum utilization of the available water resources for Socio-economic development on sustainable bases. The document includes policies to establish and institutionalize environment conservation and protection requirements as integral parts of water resources planning and project development.

**Wildlife Policy**

The Wildlife Policy was developed in 2006 by the Ministry of Agriculture and Rural Development. The prime objective of the policy is to create conducive environment for the preservation, development, and sustainable utilization of Ethiopia's wildlife resources for social and economic development and for the integrity of the biosphere/biodiversity. It covers a wide range of policies and strategies relating, amongst others, to wildlife conservation and protected areas with four categories from the highest protection ranking '*National Park*', followed by '*Game Reserve*' and '*Sanctuary*' to '*Controlled Hunting Area*'.

**National Population Policy**

This Policy was issued in April 1993 and aims at closing the gap between high population growth and low economic productivity through a planned reduction in population growth combined with an increase in economic returns. With specific reference to natural resources, the main objectives of National Population Policy are:

- Making population and economic growth compatible and the overexploitation of natural resources unnecessary;
- Ensuring spatially balanced population distribution patterns, with a view to maintaining environmental security and extending the scope of development activities;

**Policy on Public Health**

Ethiopia's health policy was issued in 1993, with the aim of giving special attention to women and children, to neglected regions and segments of the population, and to victims of manmade disasters. The priority areas of the policy are in the field of Information Education and Communication (IEC) of health to create awareness and behavioral change of the society towards health issues, emphasis on the control of communicable disease, epidemics, and on diseases that are related to malnutrition and poor living condition, promotion of occupational health and safety, the development of environmental health, rehabilitation of health infrastructures, appropriate health service management system, attention to traditional medicines, carrying out applied health research, provision of essential medicines, and expansion of frontline and middle level health professionals.

**National Policy on Women**

This Policy was issued in March 1993 emphasizing that all economic and social programs and activities should ensure equal access of men and women to the Country's resources and in the decision making process so that they can benefit equally from all activities carried out by the Federal and Regional Institutions.

**2.2.4 Conservation Strategy of Ethiopia**

Since the early 1990s, the Federal government of Ethiopia has undertaken a number of Initiatives to develop regional, national and Sector strategies for the environmental conservation and protection. Paramount amongst these was conservation strategy of Ethiopia (CSA, 1996).

It provided a strategic framework for integrating environmental planning into new and existing policies, programs and projects. It is an important policy document, which views environmental management as part of the economic development.

## **2.3 Environmental Legislations and Guide lines**

In order to achieve the environmental protection objectives fixed by the Constitution, Environmental Policy, and Conservation Strategy of Ethiopia, the Federal Democratic Republic of Ethiopia (FDRE) has issues a number of Proclamations. The major ones include the following:

### **2.3.1 Proclamation on Establishment of Environmental Protection Organs**

The objective of this Proclamation (No. 295/2002) is to assign responsibilities to separate organizations for environmental development and management activities on one hand, and environmental protection, regulations and monitoring on the other, in order to ensure sustainable use of environmental resources, thereby avoiding possible conflicts of interest and duplication of effort. It is also intended to establish a system that fosters coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels.

This Proclamation re-established the EPA as an autonomous public institution of the Federal Government of Ethiopia.

### **2.3.2 Proclamation on Environmental Impact Assessment**

The aim of this Proclamation (Proc. No. 299/2002) is to make an ESIA mandatory for specified categories of activities undertaken either by the public or private sectors and is the legal tool for environmental planning, management and monitoring.

The Proclamation elaborates on considerations with respect to the assessment of positive and negative impacts and states that the impact of a project shall be assessed on the basis of the size, location, nature, cumulative effect with other concurrent impacts or phenomena, trans-regional context, duration, reversibility or irreversibility or other related effects of a project. Categories of projects that will require full ESIA, not full ESIA or no ESIA are provided. To effect the requirements of this Proclamation, the EPA has issued a Procedural and

Technical ESIA Guidelines, which provide details of the ESIA process and its requirements.

### **2.3.2 Proclamation on Environmental Pollution Control**

This Proclamation, Proc. No. 300/2002, is mainly based on the right of each citizen to have a healthy environment, as well as on the obligation to protect the environment of the Country and its primary objective is to provide the basis from which the relevant ambient environmental standards applicable to Ethiopia can be developed, and to make the violation of these standards a punishable act. The Proclamation states that the “polluter pays” principle will be applied to all persons. Under this Proclamation, the EPA is given the mandate for the creation of the function of Environmental Inspectors. These inspectors (to be assigned by EPA or regional environmental agencies) are given the authority to ensure implementation and enforcement of environmental standards and related requirements.

### **2.3.3 Proclamation on Ethiopian Water Resources Management**

This Proclamation, Proc. No. 197/2000, was issued in March 2000 and provides legal requirements for Ethiopian water resources management, protection and utilization. The aim of the Proclamation was to ensure that water resources of the country are protected and utilized for the highest social and economic benefits, to follow up and supervise that they are duly conserved, ensure that harmful effects of water use prevented, and that the management of water resources is carried out properly.

### **2.3.4 Proclamation on Development, Conservation and Utilization of Wildlife**

This Proclamation (No. 541/2007) came into effect in August 2007 and its major objectives are to conserve, manage, develop and properly utilize the wildlife

resources of Ethiopia; to create conditions necessary for discharging government obligations assumed under treaties regarding the conservation, development and utilization of wildlife; and to promote wildlife-based tourism and to encourage private investment.

### **2.3.5 Proclamation on Development, Conservation and Utilization of Forests**

Proclamation No. 542/2007, issued in September 2007, provides for the development, conservation, and sustainable utilization of forests in satisfying the needs of the society for forest products and in the enhancement of national economy in general. It provides the basis for sustainable utilization of the country's forest resources. The Proclamation categorizes types of forest ownership as private forest and state forest. The Proclamation then goes on to give some specific direction for the development and utilization of private and state forests.

### **2.3.6 Proclamation on Expropriation of Land Holdings and Payment of Compensation**

Proclamation No. 455/2005, issued in July 2005, deals with appropriation of land for development works carried out by the government and determination of compensation for a person whose landholding has been expropriated. It includes provisions on power to expropriate landholdings, notification of expropriation order, responsibility for the implementing agency, and procedures for removal of utility lines. According to the Proclamation, the power to expropriate landholdings mainly rests on woreda or urban administration authorities.

### **2.3.7 Proclamation on Rural Land Administration and Use**

This Proclamation, Proc. No. 456/2005, came into effect in July 2005. The objective of the Proclamation is to conserve and develop natural resources in rural areas by promoting sustainable land use practices. In order to encourage farmers and pastoralists to implement measures to guard against soil erosion, the Proclamation introduces a Rural Land Holding Certificate, which provides a level of security of tenure. The MoARD is charged with executing the Proclamation by providing

support and coordinating the activities of the regional authorities. Regional governments have an obligation to establish a competent organization to implement the rural land administration and land use law. According the Proclamation where land, which has already been registered, is to be acquired for public works, compensation commensurate with the improvements made to the land shall be paid to the land use holder or substitute land shall be offered. The Proclamation imposes restrictions on the use of various categories of land, for example wetland areas, steep slopes, land dissected by gullies, etc.

### **2.3.8 Proclamation on Public Health**

Public Health Proclamation (Proc. No. 200/2000) entered into force in March 2000. The Council of Ministers may issue regulations for the implementation of this proclamation, and the Ministry of Health may issue directives for the implementation of the regulations issued under this Proclamation. The objectives of the Proclamation include: enhancing popular participation in implementing the country's health sector policy, promoting attitudinal changes through primary health care approach, and promoting healthy environment for the future generation.

### **2.3.9 Proclamation on Research and Conservation of Cultural Heritage**

Proclamation No. 209/2000 provides legal framework for Research and Conservation of Cultural Heritage. The Proclamation establishes the Authority for Research and Conservation of Cultural Heritage (ARCCH) as a government institution with a juridical personality. In addition, it has provisions for management, exploration, discovery, and study of cultural heritage and miscellaneous provisions.

### **2.3.10 Proclamation for Establishment of Tigray EPLAUA**

Proclamation No. 77/2004, issued in April 2004 by the Tigray National Regional State (TNRS), establishes the Tigray Environmental Protection, Land Administration, and Utilization Authority (TEPLAUA) as an autonomous body

that is accountable to the president of the TNRS. According to the Proclamation, the main objective of the TEPLAUA is ensure that the region's social and economic development activities are carried out in a manner that the environment and natural resources are utilized, protected and developed on sustainable basis. In addition, it has the objective to create conducive atmosphere by which the management, administration, and use of rural land of the region could be appropriately decided. Further, it has the objective to create legal and institutional framework in which all concerned parties discharge their responsibilities related to natural resources, land administration and use as well as environmental protection.

#### **2.3.11 Proclamation on Tigray Rural Land Administration and Use**

In line with the powers given to regional governments, the Tigray NRS issued this Proclamation (Procl. No 97/2006). According to Article 18(1) of this Proclamation land is a common property of the state and the people. However, a landholder with proper documentation (land registration and documentation) can rent half of his holdings to the third party according to article 6(1) and 6(3) and have a right to transfer his holdings to his offspring's or as a gift to any person in accordance with article 11(1). Article 16(1) (2) limits the lowest land holdings as 0.25 hectares and 2 hectares as the highest respectively.

#### **2.3.12 Regulation on Forest Conservation, Protection and Utilization**

This Regulation of Tigray, Reg. No. 14/2003, was issued in recognition of natural resources and forest degradation caused by the imbalance between the supply and demand of forest products (high demands for forest wood as energy source and low level of availability). It highlights the need for protection, conservation, and proper utilization of the forest resources in Tigray Region.

#### **2.3.13 EPA's Environmental Impact Assessment Guidelines**

With a view to implement the environmental laws, environmental guidelines have been issued by the EPA. Among these are the technical and procedural

ESIA guidelines, which were issued in 2000 and 2003 respectively. They are intended to guide developers, competent agencies and other stakeholders in carrying out ESIA. The Guidelines follow the conventional pattern adopted in many other countries and make provision for screening, scoping, identification and evaluation of impacts, the development of environmental management and monitoring plans, consideration of alternatives, ESIA report structure and information requirements, etc. The procedural guideline details the required procedures for conducting an ESIA, the permit requirements, the stages and procedures involved in ESIA process, and the roles and responsibilities of parties involved in the ESIA process. It also includes the categories of projects (schedule of activities) concerning the requirement of ESIA, and list of project types under each category.

## **2.4 Administrative and Institutional Framework**

### **2.4.1 Federal and Regional Administration**

The Federal Democratic Republic of Ethiopia (FDRE) comprises nine member States and two administrative councils with their own legislative, executive, and judicial powers. The FDRE has a parliamentary system of government, with two councils: the Council of Peoples' Representatives and the Federal Council. Each of the nine States and two councils has powers under the State Council for planning, determining, and implementing social and economic programmes within its own region, and each is responsible for the development and protection of its natural resource base. For administrative purposes, the States are divided into Zones, which are in turn sub-divided into Woredas. Each Woreda is again sub-divided into Kebeles, which provide local level organizations and administration. The proposed Irrigation Project is located in the Tigray National Regional State. More specifically, it is situated in Enderta Woreda of the South East Zone. Administratively Misrar Teli irrigation project is laid on Mahberegenet rural kebele.



### **2.4.2 National Environmental Protection Authority**

The National Environmental, Forest, and Climate Change Ministry (MEFCC) was re-established under Proclamation No. 803/2013 as an autonomous public institution of the Federal Government of Ethiopia entrusted with the protection and conservation of natural resources in Ethiopia. The general role of the MEFCC is to provide for the protection and conservation of the broad environment, through formulation of policies, strategies, laws and standards, which foster social and economic development in a manner that enhance the welfare of humans and the safety of the environment sustainable. All project proponents and executing bodies (agencies) in the country should operate in close cooperation with the EPA to ensure that proper mitigating measures are designed and implemented especially for projects with significant adverse impacts on the environment. Sectoral Environmental Units

According to the Proclamation No. 295/2002, every competent agency shall establish or designate an environmental unit that shall be responsible for coordination and follow up so that the activities of the competent agency are in harmony with this Proclamation and with other environmental protection requirements.

### **2.4.3 Regional Environmental Agencies**

As per the Proclamation No. 295/2002, each Regional State shall establish an independent regional environmental agency or designate an existing agency that shall, based on the Ethiopian Environmental Policy and Conservation strategy and ensuring public participation in the decision making process, be responsible for:

- coordinating the formulation, implementation, review and revision of regional conservation strategies, and

- Environmental monitoring, protection and regulation

#### **2.6.4 Establishment of Tigray EPLAUA**

Proclamation No. 77/2004, issued in April 2004 by the Tigray National Regional State (TNRS), establishes the Tigray Environmental Protection, Land Administration, and Utilization Authority (TEPLAUA) as an autonomous body that is accountable to the president of the TNRS. According to the Proclamation, the main objective of the TEPLAUA is ensure that the region's social and economic development activities are carried out in a manner that the environment and natural resources are utilized, protected and developed on sustainable basis.

### **2.5 IFAD Safeguard policies**

Based on the donor safeguard policy and fund prerequisite there are various policies to be considered. Accordingly the following policies are among the most relevant to be considered before this project implementation.

#### **❖ Indigenous people (2009)**

Policy on Engagement with Indigenous Peoples aims to enhance IFAD's development effectiveness in its engagement with indigenous peoples' communities in rural areas. It sets out the principles of engagement IFAD will adhere to in its work with indigenous peoples, and the instruments, procedures and resources IFAD will deploy to implement them. The project could not cause significant adverse impact on language, unique culture, practice and identity of the people in the project area. Thus, the project complies with indigenous people.

#### **❖ Improving access to land and tenure**

The IFAD land policy provides a conceptual framework for the relationship between land issues and rural poverty, and identifies the major implications of this relationship for IFAD's work. The policy acknowledges the complexity and dynamics of evolving rural realities and articulates guiding principles for mainstreaming land issues in the Fund's main operational instruments and

processes. It also provides a framework for the subsequent development of operational guidelines and decision tools.

❖ **Social, environmental and climate assessment procedures (2015)**

SECAP endeavors to ensure that IFAD's goal of enabling poor rural people to improve their food and nutrition security, increase their incomes and strengthen their resilience, particularly to climate change, is done in an environmentally and socially responsible manner. The procedures set the minimum standards for the assessment of social, environmental and climate change risks of IFAD projects which apply throughout the project cycle.

❖ **Environmental and natural resources policy (2012)**

IFAD's Environment and Natural Resources Policy aims to enable poor rural people to escape from and remain out of poverty through more-productive and resilient livelihoods and ecosystems by integrating the sustainable management of natural assets across its activities and its partners'.

❖ **Climate change strategy (2010)**

The goal of IFAD's Climate Change Strategy is to maximize IFAD's impact on rural poverty in a changing climate through:

- Supporting innovative approaches to helping smallholder farmers build their resilience to climate change;
- Helping smallholder farmers take advantage of available mitigation incentives and funding;
- Informing a more coherent dialogue on climate change, rural development agriculture and food security.

❖ **Policy on disclosure of documents (2010)**

IFAD's Policy on the Disclosure of Documents enables project design documents to be disclosed prior to the Executive Board session at which the project is to be considered. The Consultation also directed the Executive Board to review policy provisions with regard to the disclosure of previously undisclosed documents.

All evaluation reports and documentation submitted to the Evaluation Committee are made available to the general public on the website of the IFAD Office of Evaluation (IOE), which is part of IFAD's corporate website. Project/program design documents are disclosed to the public in their original language prior to the Executive Board session at which the project/program is to be considered. The policy also discusses the process for disclosure of previously undisclosed documents, the language of disclosure and appeals.

## **2.6 International conventions**

In addition to national environmental legislations, the Federal Democratic Republic of Ethiopia is also a party to a number of Regional and International Conventions and Protocols on Environment. The Government has established an Environmental Protection Authority, and this Authority is designated as focal point for the implementation of these conventions and protocols. These Conventions and Protocols are as follows:

### **❖ Convention on Biological Diversity**

The Convention on Biological Diversity has three goals. These are:

- Conservation of biodiversity;
- Sustainable use of the components of biodiversity and
- Fair and equitable sharing of the benefits arising from the use of genetic resources.

The convention was ratified by Ethiopia through proclamation 98/94 on May 31, 1994.

### **❖ Framework Convention on Climate Change**

Ethiopia ratified this convention through proclamation No. 97/1994 on May 2/1994. This convention takes into account the fact that climate change has trans-boundary impacts. The basic objective of this convention is to provide for agreed limits on the release of greenhouse gases into the atmosphere so as

to prevent the occurrence of climate change. It also aims to prepare countries to minimize the impact of climate change, should it occur.

❖ **The Vienna Convention on the Protection of the Ozone Layer**

The basic objective of the Convention is to combat the negative impact on the environment and human beings resulting from ozone depleting substances by reducing the amounts released and eventually banning their commercial use through internationally agreed measures. The Montreal Protocol entered into force in 1989 to facilitate the implementation of the convention.

❖ **The United Nations Conventions to Combat Desertification**

The objective of the convention is to combat desertification and mitigate the effects of droughts in countries experiencing serious drought and /or desertification, particularly in Africa. Ethiopia has ratified the convention through its proclamation no. 80/1997.

❖ **The Basel convention**

The objective of the Basel Convention is to control and regulate the trans-boundary movement of hazardous wastes. The Bamako Convention of 1991 plays a similar role at the level of the African continent.

Ethiopia ratified the Basel Convention through its Proclamation No. 357/2002. Its amendment was ratified through Proclamation No. 356/2002. The country has also ratified the Bamako Convention through Proclamation No. 355/2002.

❖ **The Stockholm Convention**

In the year 2002, Ethiopia fully accepted and ratified the Stockholm Convention on persistent organic pollutants by Proclamation No. 279/2002 designed to ban the use of persistent organic pollutants. The Environmental Protection Authority has the full mandate to implement the convention at the national level.

### ❖ **Convention on International Trade in Endangered Species of Fauna and Flora**

The objectives of the convention are to control international trade in endangered species and to ensure that international trade in non-endangered species is carried out in a manner which ensures stable markets and economic benefits for the exporting countries as well as to control and regulate illegal trade in such non endangered species, fossils and/ or their derivatives. Ethiopia ratified the convention through Proclamation 14/1970. The mandate to implement the convention at federal level is the responsibility of the Ethiopian Wildlife Protection and Development Organization.

- ❖ A workable monitoring plan and system should be designed by the relevant stakeholders for continuous implementation and auditing of proposed management plan.
- ❖ The project owner should be considering the capacity limitation of relevant stakeholders and institutions and allocating financial budget to capacitate specially kebele and wereda personnel.
- ❖ Based on the proposed management plan parameters the project owner and donor should responsibly allocate environmental and social management cost early before the project inauguration.
- ❖ To obtain the overall project sustainability and effective implementation of recommended project enhancement measures a reasonable monitoring cost should be allocated early before project's major activities began.

### **3 Project description and Components**

#### **3.1 Location**

The project wereda is located in the Se zone of Tigray. It is bordered with kilte Awlaelo in the north, Hintalo woreda in the south, Degua Tembien woreda in the west and the Hintalo wereda and Afar region in the east. The woreda is composed of 17 rural Tabyas and 56 sub kebelles. As a result of land degradation and shortage of rainfall, the farmers of the woreda are suffered from relatively low and seasonal agricultural production.

Typically the proposed irrigation area is mainly located at kebele administration called Mahbere Genet of a locality known by Tsilwe. The irrigable area is situated at about 3 km south of the region capital city Mekelle alongside the Hagere selam town about. The site is accessible by the ongoing main asphalt road from Mekelle to Hagere Selam and typically through 2 km on asphalt and 1 km gravel road west ward Mekelle. Towards its absolute geographical location the proposed irrigation project is located at tabia Mahbergenet at a locality known by Misrar Teli command area and the scheme is situated at the middle river course at Northing 545155.03 and Easting 1500099.06 UTM.

#### **3.2 Justification and need for the project (Rationality)**

The project wereda Enderta in general and the project target district, Mahbere Genet tabia in particular is naturally endowed with rich water and land resources that can be utilized for irrigated agriculture. On the other hand, the wereda and the project site have been faced with recurrent droughts which are caused by the erratic nature and high spatial and temporal variability as well as low total amount of rainfall. Back ward agricultural practices also contributed to low productivity and accelerated land degradation, which aggravates the impacts of the droughts.

The population living in the project target area has rural based economic and social process. Poverty is concentrated in the area where connectivity to basic

social services and average educational attainment are relatively low, and agricultural labor is an important source of employment.

Due to backward agricultural practices and long term consequence unsustainable rain fall and climate change affect the majority of the people in the project site live in subsistence primarily agriculture economy experiencing low livelihood status. Hence emergency irrigation projects like this one could sustainably solve the drought incident and could improve the livelihood status of the project affected people in the project area and its surrounding too.

Modern irrigation practice is among the typical adaptation mechanisms and best mitigation measures to handover the enduring incident of climate change.

Therefore helping this community through modern irrigation projects become more compulsory and timely response too.

However, construction irrigation structures does not always have high socio-economic benefits without causing adverse effects to the environment. Serious disruption of the bio-physical resources, social structures and infrastructures can be resulted in a fault project designed and construction without considering socio-environmental issues.

Therefore, integrating socio-environmental concerns into the proposed project design and construction activities appeared to be essential to minimize adverse impacts and to enhance benefits from the project.

This partial ESIA report therefore discusses environmental and social issues of the project and comprises environmental mitigation and management plans to be implemented so that the project would be environmentally feasible, socially acceptable and economically justifiable.

### **3.2 Project area influence**

The influenced area under this project is typically Mahbere-genet rural administration kebele at Tsilwe, locality where by all the project affected peoples both positively and negatively are residing. The number of households expected



to live in this area is some 7205 however the household number expected to be involved directly involved in the proposed small scale irrigation scheme is about 98 households.

The irrigated land under this scheme has coverage of some 50 ha which will be grown through surface irrigation system through gravity using different irrigation canal excavation and alignment. Based on the agronomist feasibility study report typical crops that will be grown in the project area agro-ecological zone comprises sorghum, teff, maize, millet and other vegetables and fruits.

### 3.3 Major project components

The irrigation project is proposed to execute in Enderta wereda Mahbere Genet rural administration district at locally known by Tsilwe through utilizing the surface water from perennial river of Misrar Teli planned to irrigate some 50 ha from the lower catchment of the river using river diversion. The scheme whereby the diversion located is having a longitude: 545155.03 and latitude: 1500099.06, with the total catchment area of 322.68 km<sup>2</sup>.

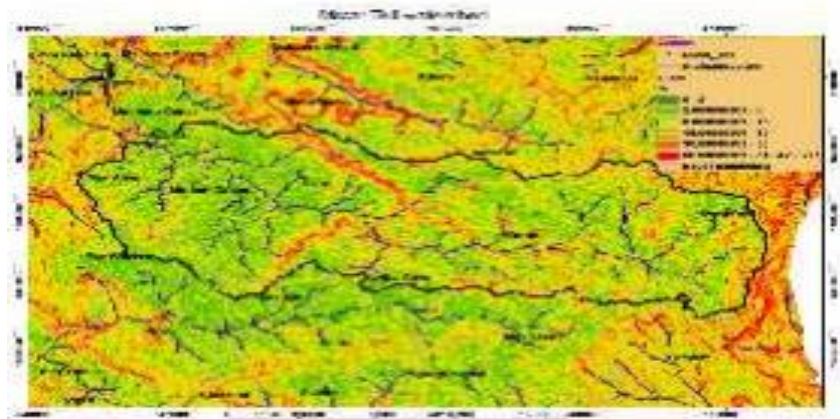


Figure 0-1 Site map of Misrar-Teli diversion scheme

The project comprises major structure construction and installation of river diversion, irrigation canal and some relevant engineering layout throughout the identified irrigable command area.

**Table 0-1 Salient Features (components) of the project**

S#	Major project components	Remarks
1	Name of the project	Misrar Teli SS irrigation project
2	Irrigation head work design type	Revir diversion
3	Main canal length	3.5-4 km
4	Weir description	30 m width * 1.8 m height
5	Net Scheme (irrigable) area of the projec	50
6	Total water demand for the irrigable are	200 m/s
7	Recommended irrigation method	Gravity

### 3.4. Irrigation water quantity and Irrigation Method

The flow measurements have been made using floating method only twice in the months of November and December. The Average flow 200 L/second. It is assumed that, the flow is distributed linearly for the rest unmeasured months because we consult farmer's senior in traditional irrigation from MsrarTeli. The river is perennial and it does not dry even in the pres. Command area has been determined for the capacity of the river without any deficit of water. As a result of sufficient flow of MsrarTeli River the duty is calculated using 12 hours operating time. The duty of MsrarTeli irrigation is 1.9 l/s/hectares. Command available 52.5 hectares. Total needed water for MsrarTeli is 99.75 liters approximately 100 liters from the lean flow measured using the float method the 200 liters/second the 100 l/s has been used for a capacity of irrigating 52.5 ha using the duty 1.9 l/s/hectares , the rest flow is left for the existing downstream diversion Tslwe and downstream biodiversity.

### 3.5. Proposed crops and yield

The farmers produce food grains once a year using the winter rainfall. They have traditional experience in utilizing the available perennial river for vegetable crops and other income generating crops during the dry season in the area.

However, under project condition, new cropping pattern is proposed both for the Dry season and Wet season conditions because of the following reasons:

- Quantity of selected crops for each growing system
- Food habit of the people
- The need to achieve food security
- Market demand and market prices

**Table 0-2 Attainable Yield level (Q/ha) with irrigation, improved varieties and fertilizer.**

S/n.	Crops	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	5 <sup>th</sup> Year
1	Pepper	16	18	20	25	30
2	Onion	220	250	300	320	350
3	Potato	250	260	280	320	350
4	Cabbage	170	200	220	230	250
5	Tomato	200	230	260	300	380
6	Wheat	25	35	40	45	55
7	Barley	25	30	35	40	50
8	Sorghum	25	30	35	45	55
9	Teff	10	12	15	20	25
10	Mango /Onion1-2 year/	160	180	200	220	300
11	Banana/Pepper1-2 year/	180	200	250	280	300

Source: Agronomy Study Report 2018

### 3.6. Agrochemicals and Application Method

In areas developing under irrigation, weeds are very problematic due to the availability of enough moisture. Unless they are weeded timely, the weeds will cause severe yield loss. Therefore, due attention should be given to control weeds. Most weeds growing in the study area can be controlled by frequent

plowing, using clean seeds, timely and frequent hand weeding and maintaining soil fertility by applying well-decomposed manure and compost.

Insect pests and diseases are also very problematic in irrigated area. Especially if there is no crop rotation, diseases, and insect pests will build up through time and will cause significant yield loss. The best method to control pests is applying integrated pest management system. This system integrates all control methods aimed at minimizing pest damages and gives priority to non-chemical control methods such as using resistant varieties, crop rotation, field sanitation, using disease-free seed and plants, optimum plant spacing, adjusting sowing times, and providing an optimum growing condition for the crops. Chemicals are used if there are no other control possibilities.

**Table 0-3:** Potential pest infection and management system

S/No	Crop	Pests	Chemical	Chemical dose	Mechanism of usage	Cultural protection
1	Onion/ Potato/ Cabbage	Onion thrips	Karate5%EC Dimethioate40%	0.4 lt/ha 1 lt/ha	Spraying Spraying	Crop rotation, sowing tolerant crops, sanitation, deep plowing, weeding
		Cutworm	Dursban48%EC Diazinon60%EC	3 lt/ha 3 lt/ha	Spraying Spraying	Crop rotation, sowing tolerant crops, sanitation, deep plowing, weeding
		Aphids	Karate5%EC Dimethioate40%	0.4 lt/ha 1 lt/ha	Spraying Spraying	Crop rotation, sowing tolerant crops, sanitation, deep plowing, weeding
2	Pepper	Aphids	Karate5%EC Dimethioate40%	0.4 lt/ha 1 lt/ha	Spraying Spraying	Crop rotation, sowing tolerant crops, sanitation, deep plowing, weeding
		Bollworm	Diaznon 60%EC Karate5%EC	2.5 lt/ha 0.4 lt/ha	Spraying Spraying	After harvest immediate & deep plowing, crop rotation, sanitation, sowing at a time
		Cutworm	Dursban48%EC Diazinon60%EC	3 lt/ha 3 lt/ha	Spraying Spraying	Crop rotation, sowing tolerant crops, sanitation, deep plowing, weeding
3	Tomato	Bollworm	Diaznon 60%EC Karate5%EC	2.5 lt/ha 0.4 lt/ha	Spraying Spraying	After harvest immediate & deep plowing, crop rotation, sanitation & burning of residual, sowing at a time
		Whitefly & Aphids	Krate5%EC Diazinon60%EC	0.4lt/ha 2lt/ha	Spraying Spraying	After harvest immediate & deep plowing, crop rotation, sanitation & burning of residual,
		Blister & Pollen beetles	Malathion 50%EC Fenitrothion 50%EC	2 lt/ha 1.5lt/ha	Spraying Spraying	After harvest immediate & deep plowing, crop rotation, sanitation, sowing at a time
		Grasshopper	Carbaryl 85%WP Malathio50%EC	1.5 lt/ha 2lt/ha	Spraying Spraying	Deep & frequently plowing, Crop rotation, sowing at a time.
6	Wheat	Grasshopper	Carbaryl 85%WP Malathio50%EC	1.5 lt/ha 2lt/ha	Spraying Spraying	Deep & frequently plowing, Crop rotation, sowing at a time.
		Cutworm Cricket	Diazinon50%EC Indosulfen35%EC	2. 5 lt/ha 2 lt/ha	Spraying Spraying	After harvest immediate collection of yield and destroying of moulds sowing vetiver grass
7	Barley	Cutworm Cricket	Diazinon50%EC Indosulfen35%EC	2. 5 lt/ha 2 lt/ha	Spraying Spraying	After harvest immediate collection of yield and destroying of moulds sowing vetiver grass
		Grasshopper	Carbaryl 85%WP Malathio50%EC	1.5 lt/ha 2lt/ha	Spraying Spraying	Deep & frequently plowing, Crop rotation, sowing at a time.
8	Sorghum	Stalk Borer	Karate5%EC Cypermethrine1% Gr.	0.4lt/ha 3kg/ha	Spraying Granule	Collect and burn infected aftermath, Deep & frequent plowing.
		Blister & Pollen beetles	Malathion 50%EC Fenitrothion 50%EC	2 lt/ha 1.5lt/ha	Spraying Spraying	After harvest immediate & deep plowing, crop rotation, sanitation, sowing at a time
9	Teff	Shoot fly	Trichlorofo95%SP Fenith.50%EC	1kg/ha 1.5lt/ha	Spraying Spraying	Deep & frequently plowing, Crop rotation, sowing at a time.
		Grasshopper	Carbaryl 85%WP Malathio50%EC	1.5 lt/ha 2lt/ha	Spraying Spraying	Deep & frequently plowing, Crop rotation, sowing at a time.

**Table 0-4 Potential Diseases of the command and controlling measures**

S/No	Crop	Disease	Chemical	Chemical dose	Mechanism of usage	Cultural protection
1	Onion/ Potato/ Cabbage	Root & bulb rot /Mujele/	Benamol Vencalozine Dichlorine	- - -	Seed dressing or soil treatment	Sanitation, Crop rotation, Select tolerant varieties, rotation Determine seed rate etc.
		Root rot /Sur abesbis/	Tihram Binomial Capton	250Gr./Qu. - -	Seed Dressing or Spraying/ soil treatment/	Early plowing Sowing tolerant vari.
		Rust /Himodya/	Metalaxyl Mancozeb Apron star	3 kg/ha 3 kg/ha 250 gr./qt	Spraying Spraying Dressing	Crop rotation, seeds dipping in cattle urine
2	Pepper	Root rot	Tihram Bnomil Capton	250Gr./Qu. - 3-4kg/ha	Seed dressing - Spraying	Early plowing Sowing tolerant vari.
3	Tomato	Powdery mildew	Bileton 250 EC Bileton250%wp	0.4lt/ha 0.5kg/ha	Seed dressing Spraying	Early plowing Sowing tolerant vari.
		Late Blight	Metalaxyl Mancozeb Kisayd 101 wp	3kg/ha 3kg/ha 4. 5kg/ha	Spraying in 7-10 days interval Spraying	Sanitation, weeding, determining seed rate, tolerant varieties
4	Milllet	Smut	Venesit Fernasen-D Carboxyl		Seed dressing Seed dressing Seed dressing	Crop rotation, seeds dipping in cattle urine
5	Wheat/ Barley	Smut	Venesit Fernasen-D Carboxyl		Seed dressing Seed dressing Seed dressing	Crop rotation, seeds dipping in cattle urine
		Rust	Manieb /Mancozeb/	20Gr.diluted in 10 lt. of H <sub>2</sub> O	Spraying in 7-10 days interval	Sanitation, weeding, determining seed rate, tolerant varieties
		Sorghum downy mildew/Shamla /	Tiram, Binomial, Capton	250Gr./Qu.	Seed dressing	Sowing clean seed, Roughout infected ones, Rsistantvarites
6	Teff	Rust	Manieb /Mancozeb/	20Gr.diluted in 10 lt. of H <sub>2</sub> O	Spraying in 7-10 days interval	Sanitation, weeding, determining seed rate, tolerant varieties

Source: Agronomic Study Report 2018

### 3.8 Source of construction materials

Irrigation projects are among the potential construction material sectors due to this a locally available and accessible materials are identified by Geological investigation experts during field investigation, the existence of natural construction materials required for the construction of the various proposed engineering structures were assessed, and possible quarry sites and borrow areas have been identified within the vicinity of the study area as close to the project site in the river bed since there is no need mining the farm land. The materials needed for the construction of the structures include rock for masonry stones, aggregates (both coarse and fine), and water. Stone for masonry, and aggregates (both coarse and fine) is available within its nearby river Gereb Giba. And also Water for the construction is available within Misrar Teli River itself.

### 3.9 OHS/Risk and hazard management

Due to the massive construction activities of the project main structures like diversion, main canal and other secondary infrastructures of the project a various health and safety issues and unexpected risks could result both on the operational team and some nearby affected community like injury, car accident and some machinery accidents typically during the construction phase of the project.

Due to this a risk management plan should be early designed to check the potential health and risks and to fulfil the safety demand of project workers (construction crew) and some potentially affected people. Accordingly the hazard management system incorporates the following parameters i.e

- ❖ Providing protective equipment (like helmet, eyeglass and gloves) to the construction crew
- ❖ Placing heavy machinery in safe area

- ❖ Applying traffic accident controlling signs
- ❖ Providing first aid kits and emergency health service
- ❖ Bordering danger zone during heavy construction and excavations
- ❖ Preparing alternative pedestrian
- ❖ Use best schedule for construction to minimize risk



### 3.10 Alternatives of the project

The purpose of analyzing alternatives is used to ensure the project overall sustainability and select a best design and location among the possible options. To implement this project different options are analyzed to choose the feasible alternative that brings sustainable development.

This ESIA study has therefore sought to identify and assess alternatives to the proposed developments so as to have the best working models that may not have adverse effects or those that have the least minimal effects. The best alternative is to be selected based on minimal negative impacts and through a economic feasibility and social acceptability analysis. Accordingly, the following alternatives are possible in the project area.

#### 3.10.1 without or with the project

**No project alternative** prevents the execution of the project on the proposed irrigation potential site and scheme Thus; it limits the socio-economic development of the project area and prohibits the advantages of the local community that gains from modern irrigation development practices. If this alternative is applicable in the project area a couples of socioeconomic and technological progress expected to bring like increasing agricultural products, insured food security and improvement of living standard, stability of agricultural goods' price and introducing of sound technology will be missed by the project target community and the region. The project is evaluated based on its national, regional and international legal requirement, environmental friendly, economic viability and social acceptability accordingly there is no rational conditions to reject the implementation of the project in the project are. Accordingly, the "without the project" alternative is not workable and acceptable in this project case. Therefore, by checking and minimizing the environmental potential impacts and enhancing its socioeconomic feasibility the "**with the project**" option become more effective and should be accepted.

### 3.10.2 Human and animal foot path Design option

The place where by the scheme is proposed to locate is previously used as alternative crossing path of the river Misrar-Teli by some community of the project area especially that of Tselwe locality while the reservoir is constructed at both abetments (right and left) the existing foot path would be interrupted due to this a best design option which will be incorporate human foot path should be early considered parallel to the reservoir at two meters towards the west.

In addition to this the scheme will have different irrigation canal extension throughout the command area this would bring additional effect on the movement of both animal and human unless alternative design is integrated the formal animal movement for grazing and water access would be hindered.

In addition to the integrated foot path design consideration to reduce the effect of hindering the movement of animals and human population a due attention should also be given to the following existing four foot paths identified during the onsite IEE of the command area having these absolute geographical locations:

- ❖ Path-one, lat-054410 and longt-1501180 UTM
- ❖ Path-two, lat-0544187 and longt-1501148 UTM
- ❖ Path-three, lat-0544289 and logt-1501165 UTM
- ❖ Path-four , lat-0544330 and longt-1501224 UTM

### 3.10.3 Construction period alternative

An appropriate construction season is among the many factors that could affect the sustainability of the project and well guaranteed the installation of irrigation infrastructures like the river diversion and canal assembly therefore the schedule for irrigation infrastructure works should be arranged after the rainy season in order to reduce the risk of major construction activities damage from unexpected flooding and landslide incidents.

Similarly if the construction and land excavation activities would be planed during dry season severe environmental degradation on land and soil would be

minimized. Agricultural off season construction period could also help to check some social effects like interrupting cultivated land preparation, crop harvesting and would enhance benefits of the local community by creating temporary job opportunity by engaging them during construction works.

## **4 Baseline information of the project area**

This section of the study describes the major physical, biological and socio-economic profile of the environment by which the project is intended to execute. Hence, typically help to illustrate in which type of environmental and social settings is the project implemented as so to revealed and predict the potential adverse effects of the project.

### **4.1 Physical Environment**

#### **4.1.1 Location and Topography**

The project wereda is located in the Se zone of Tigray. It is bordered with Kilte awlaelo in the north, Hintao wejerat woreda in the south, Dogea Tembien woreda in the west and the Afar region in the east. The woreda is composed of 17 rural Tabyas and 56 sub kebelles. As a result of land degradation and shortage of rainfall, the farmers of the woreda are suffered from relatively low and seasonal agricultural production. On the other hand, the woreda is endowed with vast water and land resources suitable for irrigation. This has justified the need of reservoir (diversion) for irrigable agriculture. Hence, the command area is suitable for irrigation which lied at the highly irrigable land endowed and potential of surface water available plain area of Tsilwe.

Typically the proposed irrigation area is mainly located at kebele administration called Mahbere Genet of a locality known by Tsilwe. The irrigable area is situated at about 2 km west of the region capital city Mekelle alongside the Hagera Selam town. The site is easily acceccible by the main asphalt road from Mekelle city while the command typically accessible through 1.5 km of gravel road west ward of Romanat town. Towards its absolute geographical location the proposed irrigation project is located at tabia Mahbere Genet at a locality known by Tsilwe and the scheme is situated at the middle river course of the scheme longitude: 545155.03 and latitude: 1500099.06 with the total catchment area of 322.68 km<sup>2</sup>. Topographically the project wereda is dominated with uneven slope

terrain and fragmented topography full of undulated and gorges. In addition to this the low land part of the wereda especially that of the proposed project locality is highly dominated by vast plain land suitable to irrigation development.

#### **4.1.2. Geology and Geomorphology**

Misrarteli diversion Site is covered with dolerite well bedded black limestone and carbonaceous variegated yellowish limestone rocks and in addition to that there is residual clay with boulder and soil at the left and right abutments.

##### **Right Abutment**

It is covered with a residual clay with boulders and gravel soil overlain a well bedded limestone rock

##### **Left Abutment**

It is made of a Residual soil relatively thicker than the right abutment underlain by well bedded limestone rock.

##### **River Center**

It is covered with jointed dark dolerite and at left side from the center there is a residual clay soil with gravel and sand soil.

#### **4.1.3. Soils**

According to soil survey study results, majority of the command area soil is deep (100-150 cm) and From field assessment majority of the command area soil texture is sandy clay loam which is deposited by water erosion and weathered rock transformation from upper part of the area and within. The color of the soil is red to brownish. Based on physical and field assessment of topsoil texture, topography, leveling requirement, rock out crop areas and slope majority of the schemes command area can be used for irrigation purpose with key limitations on soil fertility, effective soil depth and sheet erosion of the soil.

Soil management practices that improve soil fertility like addition of manure and artificial fertilizer, soil and water conservation measures are also highly recommendable for the areas to improve the existing productivity and sustainability of the land. The texture of the soils varied between loam, silty clay and clayey classes. The major soil types of the study area are: Vertisols, Cambisols and Regosols by studying and observing soil profile on pits and already existing gullies. The potential of command area with recommendable soil type and river water flow potential is about 50 ha.

As it was seen in the field the ecological condition of the watershed has been disturbed due to the presence of less management of the natural resource like the vegetation, soil and water. Many of the indigenous trees and shrubs species have been deforested and much of fertile soil is washed away from the steep sloped hillsides. These causes severe land degradation and reduction in production affecting the socio economic and environmental well-being of the community.

#### **4.1.4. Climate**

According to (WOA 2017 reports) and official statistical buliten majority, 99% of the woreda lies within the Mid highlands ('Woinadega') agro climatic zone.

Typically the project area and proposed irrigation scheme lies within the Tapid three agro ecological zone characterized plain lowland. The SE Tigray and the project wereda is characterized by the mono-modal type of rainfall which has a single maxima rainfall pattern.

##### **4.1.4.1. Rainfall**

There is no full metrological data in the command area. The rain fall data is obtained from Mekelle air port metrological station. The annual and monthly rainfall of the command area is estimated from 22 years records of the wereda stations.

The rainfall data is taken from nearest metrological station Mekele Alula abanega airport this data shows that the mean annual rainfall of 20 years between (1992-

2011G.C) is 602.3 mm. Out of the total amount of 602.3mm annual rainfall 28%(170.5 mm) of the rain is received only in two months of the year (July and August). June and September contribute 12%(74.2 mm) and the remaining eight months receive 60%(365mm) of the annual rainfall. Moreover, the distribution of rainfall is not uniform throughout the days in the season. The rainfall pattern shows that supplementary irrigation is required during all the months of the year. Average daily temperature varies from 27.10c to 8.80c. The maximum temperature reaches highest in June (27.10c) while the minimum temperature drops to its lowest in January (8.80c). Thus, the temperature is suitable for growing variety of crops including cereals, vegetables, and fruit crops. The climatic zone of the site is under /SM3/ which is Tepid Sub-moist mid-land, since LGP is between 61-120 days and the average temperature is between 110c to 210c and the Elevation is also between 1600-2400 m asl. (Source: Forestry, Land use and soil conservation Dep't MOARD, July 2005 Addis Abeba.)

#### **4.1.4.2. Temperature**

From the data, it is observed that mean monthly maximum and minimum temperature ranges from 18 degree centigrade to 25.5 degree centigrade and from 8.5 degree centigrade to 12.5 degree centigrade respectively. The average daily temperature is 16.8 °c.

The maximum temperature reaches highest in April (22 °c) & May (25 °c) while the minimum temperature drops to the lowest in January (8.5 °c) which indicates that the area lies in tepid three climate zone and hence the proposed crops are grown in this area are highly affected by the given temperature.

Thus potential of crops that can be grown in the project area can be listed as follows:

- Cereals- Sorghum, Teff, Maize, Millet, Wheat, Barley
- Pulses-Field peas, Chick pea, Lentil

- Vegetables-Pepper, Tomato, Onion, Cabbage,
- Fruit crops-Mango, Avocado, Guava, Orange, Banana, Papaya etc

#### **4.1.5. Hydrology and drainage pattern**

Based on the soil study of this project, the majority of the command area is situated on flat to moderately slopping area. However, since the majority of the soil is sand soil there will be no problem of water logging during rainy season. But the only challenge which can be easily revealed will be the scarcity of soil nutrients and improper utilization and poor management of irrigation inputs like agro-chemicals.

The study area is highly endowed by many perennial rivers like upper stream of may-kanatsu, Elala and two small seasonal streams in addition to this at the immediate upper catchment of the scheme some 2 km spring development (ground water discharges). Most of the streams including the project target river drained to the nearby major river Gereb-Giba which is among the main tributaries of Tekeze river basin.

The water source and hydrological balance of the under utilization river was investigated in cooperation with hydrologist and other relevant study team members based on the field flow measure and other relevant reliable information's the river possess adequate volume of base flow having a measured lean flow of 200 l/s.

#### **4.1.6. Water Resource and stream flow**

There is modern irrigation diversion scheme downstream of the MisrarTeli headwork location. The downstream diversion (Tslwe) is designed for 30 hectares but the farmers irrigate 35 hectares measured during field study for Misrar Teli diversion.

The flow measurements have been made using floating method only twice in the months of November and December. The Average flow 200 L/second. It is assumed that, the flow is distributed linearly for the rest unmeasured months



because we consult farmer's senior in traditional irrigation from MsrarTeli. The river is perennial and it does not dry even in the presence of drought. Command area has been determined for the capacity of the river without any deficit of water. As a result of sufficient flow of MsrarTeli River the duty is calculated using 12 hours operating time. The duty of MsrarTeli irrigation is 1.9 l/s/hectares Command available 52.5 hectare. Total needed water for MsrarTeli=99.75 liters approximately 100 liters from the lean flow measured using the float method the 200 liters/second the 100 l/s has been used for a capacity of irrigating 52.5 hectare using the duty 1.9 l/s/hectares, the rest 50% (100 l/s) flow is left for the existing downstream diversion Tsilwe and downstream biodiversity.

#### **4.2 Natural (Biological) Environment**

The SE part of the region is among the highly degraded part of the country previous agricultural practices, housing and settlement pattern, massive fuel energy utilization and repeatedly done war have play a vital role to have a tremendous decrease in biological composition and resulted by ecological imbalance in the study area. Due to this the composition of flora and fauna is very limited both in coverage and composition too. Greater part of the flora composition is rarely seen the lowland kola area of the wereda especially the area by which this irrigation project is select to be implemented is among the rich sites of the wereda both in its flora and fauna variety and areal coverage. Greater part of the project is some 95% is grown by three main families of acacia plant species that of, seraw and kileaw. In addition to this the lowland part of the project kebele is also highly known for its enlarged rarely grown big tree species like Daero, Sagla, Awhi and Awlie but these tree species are currently at risk only rarely survived at homestead of households and church near the project scheme.

The fauna abundance in the study area also directly related and affected by the flora concentration too. Hence, since great part of the project area is highly degraded, affected, and interrupted by human and natural incidents one can easily concluded that the composition of wild animals is very poor and limited to. Accordingly only few in number fauna species like local hayena, local fox, rabbit and a variety of bird species are rarely seen the lowland relatively denser forest districts.

Special attention should be given during project construction phase while irrigation canal aligning and access road expansion since the site where the project proposed to line up the main irrigation canal.

### **4.3 Irrigation water quality concern**

Irrigation water pollution in the project area is suspected to occur as a result of contamination of underground and surface water sources by substances harmful to living things. The identified major water pollutants in the upper catchment areas of the project are identified to be of chemical, biological, and physical nature that degrades the dam water quality. Accordingly, the likely pollutants of the project area are classified into 3 main categories: agro-chemicals, excess organic matter from upper catchment, and sedimentation due to the degraded, undulated, and sand soil domination in the upper catchment.

Agro-chemicals are being used to kill unwanted pests and weeds on farms and fertilize the soil for crops. They may be collected by rain water runoff and carried into streams and lakes or dams if applied abundantly. Irrigation water can be contaminated with pesticides and nitrates, a pollutant often derived from fertilizer run off. In this case the accommodation of pollutant particles from farm fields of the upper catchment is recognized in its likely effect though it will be less significant.

The major agro-chemicals which are being used in the upper catchment of the reservoir are mainly fertilizer, pesticides, and insecticides. They use mainly for crop and vegetable production and protection. The chemicals include fertilizers, pesticides, and herbicides. Fertilizers are used to temporarily bridge the nutrient deficiency of soils and, thereby, increase crop production. The frequently used types of fertilizer are DAP and Urea. However, according to agronomy study and WOA reports, the adoption rate of farmers on their use is very low.

Soil erosion led sedimentation of soil particles, carried from the sloppy and fragmented upper catchment towards the reservoir will also be a pollutant if it is not treated adequately. As discussed in the land use section of this study, soil erosion produced by the removal of soil-trapping trees, unprotected farming, and overgrazing in the upper catchment areas carried by running water or floods from degraded areas will cause sedimentation which is a major pollutant in the study area. The negative impact of sedimentation on the reservoir can be generalized in the following manner:

- ⇒ It introduces too much nutrient matter which lead to eutrophication,
- ⇒ Sediment soil covers reservoir bed block fish production
- ⇒ It diminishes the water holding capacity of the reservoir and shortens its life span.

Another irrigation water pollution and contamination concern is refuse wastes from Mekelle city which have a very poor and improper municipal waste management. Through time such incident could affect both the quality and quantity of the irrigation water unless a proper management system consider during design phase of the project.

### 4.3.1 Project Water Quality investigation

During the initial environmental evaluation phase of this ESIA study irrigation water quality for this IFAD sub project (Misrar-Teli site) was among the concerned issues since this site was suspected for its upper catchment municipal and industrial waste sourced from Mekelle city and quiha town, contamination and excess nutrient accumulation from CaCo<sub>3</sub>, Nitrate and sulphate due to this a sample tap water measurement is conduct at site level dated 09/ 04/2010 E.C where by a selected four (4) samples were collected from different pollution suspected sites upper stream of the reservoir. A purposive sampling technique was applied for the reason of purposely evaluating the suspected districts and some small tributaries of the River.

Accordingly the samples were collected from the nearby spring, deep weel and tributaries and from the proposed scheme site reservoir.

To examine the water quality results the collected tap sample water was sent to Mekelle university laboratory center immediately after 6 hours as collected at 2:00 am to 3: am arrived at 9:00 pm local time at the same day in 09/04 /2010.

Accordingly, the water samples were investigated for major irrigation water quality parameters and standards like: EC, TDS, Acidity (PH), and Salination.

**Table 4-1 Major irrigation water quality parameters**

ID	Parameter	Measured laboratory results			Allowable standard	FAO
		<i>Min</i>	<i>Max</i>	<i>Range</i>		
1	TDS mg/l	1218.71	1265.50	1218-1266	450-2000	
2	SAR%	0.33	0.45	0.3-0.5	2%	
3	EC $\mu$ S/cm	1709	788	752-788	700-3000	
4	PH	8.23	8.34	7.6-8.2	6.5-8.5	
5	CaCo <sub>3</sub>	0.57	2.18	0.6-2.2		

**Source:** MU Laboratory measured results, 01/01 2018.

According to table 3, MU laboratory results water quality analysis for the surface water of **Misrar Teli** in relation to the most important parameters that should be

considered for irrigation water allowable standards, including the initially suspected four (4) water quality concerns during the IEE study phase additional 9 (nine) parameters for excess nutrient concentration was investigated accordingly all the results were compared versus the FAO 1989 IWQ standard as a result all results indicate from very low effect to moderate so we can confidentially conclude that irrigation water quality is ranged at the allowable standard though some slight effects that can technically managed to appear EC and TDS concentration.

A salinity problem exists if the salt accumulates in the crop root zone to a concentration that reduces the crop yield. In irrigated areas, the salts often originate from a saline, high water table or from salts in the applied water. Yield reduction occurs when the salts accumulate in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solution, resulting in a water stress of the crop According to FAO water quality guideline for agriculture (FAO, 1989). Therefore, the moderate TDS and salinity concentration should be managed by selecting crops which can tolerate this range of nutrient and salinity concentration.

#### **4.4 Land Use/ Cover pattern of the Project area**

Land use and land cover of the project target area including the specific scheme site is described based on the information obtained from relevant sources kebele level , field observation, wereda land administration office and other relevant studies in the area.

Land use land cover is among the crucial environmental baseline information which help to reveal the natural and built environment performance to tolerate and absorb the likely appear potential adverse impacts emanated as a result of this project implementation in the specific target area.

Based on the IEE study and official data obtained from Mahbere Genet tabia administration and wereda EPLAUO majority of the land use/cover in the

project area categorized under five groups thus, cultivated, grazing , settlement , bush and wood (forest) and Miscellaneous land the total coverage of these land use units is told to be some 3258 ha. From the total cultivated land irrigation comprises 202 ha.

**Table 4-2 Land Use and Land Cover of project/ catchment area**

Land use type	Slope (%)	Area (km <sup>2</sup> )	General condition of each land uses
<i>Cultivated land</i>	2-8	81.25	Some of the cultivated ands have been well treated with different soil and water conservation measures
	8-15	110.56	
	15-30	39.29	
<i>Grazing land</i>	8-15	0.34	It has low vegetation cover, not well treated with SWC and it has shallow soil depth
	15-30	29.90	
	30-50	7.95	
<i>Forestland (area closures)</i>	8-15	0.73	It has good vegetation cover and treated with hillside terrace, and it is protected as area closure
	15-30	0.49	
	30-50	0.46	
	>50	0.89	
<i>Homesteads</i>	2-8	24.70	Good vegetation cover with better soil and water conservation measures
	2-8	1.76	Village area Good vegetation cover with better soil and water conservation measures
	8-15	13.37	Areas dominated with asphalt, stone pavement and corrugated sheets coverage
	8-15	1.75	Village area_Good vegetation cover with better soil and water conservation measures
	15-30	1.81	Areas dominated with asphalt, stone pavement and corrugated sheets coverage
	15-30	3.26	Village area moderate vegetation cover with better soil and water conservation measures
<i>Miscellaneous land</i>	—	4.17	Area occupied with rock out crops
<b>Total</b>		<b>322.68</b>	

Source: watershed study report, 2017

Based on the official data from watershed study report for the project catchment in table 4, the land use and land cover patterns of the project catchment the total area is 322.68 KM<sup>2</sup> of this majority which is 231 km<sup>2</sup> (72 %) covered by cultivated land, settlement area 46 (15%), grazing 38 km<sup>2</sup> (12%), Miscellaneous land 4.2 km<sup>2</sup> (1.3%) while the remaining area of the catchment is which is 2.8 km (0.8%) is shared by forest land rehabilitated by area closure program.

Thus, we can conclude that due to rapid human and animal population growth land use change is rapidly experienced in the previous two decades thus most of the forest and bush land are highly affected by urbanization, cultivated land and grazing area expansion.

In general, major environmental problems of the study area are:

1. Deforestation; due to farmland expansion, illegal cutting of trees for fuel and construction are common on the upper catchment areas;
2. Free grazing of range lands is the common cause for forest land degradation ;
3. Lack of integrated land use planning led to over cultivation
4. Recurrent drought that led to inadequacy of rain and agricultural productivity.
5. Land degradation due to soil erosion and misuse of land

Accordingly the catchment has a highly fragile land use system affected by over cultivation and grazing and the share of protected forest ecosystem is very limited thus, it's highly recommended to work on integrated soil water conservation and biological conservation to secure the sustainability of the scheme and the project too.

#### **4.4.1 Conservation practices in the project area**

The ecological condition of the watershed has been disturbed due to inadequate management of the natural resources mainly the vegetation, soil and water. Such problem finally will lead to severe land degradation and hence reduction in productivity of land resources, thereby affecting the socio economic and environmental well-being of the community and aggravated flood sedimentation.

The watershed of the irrigation site is in unprotected condition with pre dominantly free grazing; deforestation accompanied with very less/no conservation efforts. Grazing and sparsely distributed forests dominated by thorny acacia bushes has greatly influenced the command area.

Sheet, rill and gully erosion are observed in the command area. Therefore, construction of site specific soil and water conservation structures are essential to conserve and stabilize the command area. Sediments transported from hilly and unprotected lands have to be minimized. Otherwise, this will silt up the structure area and reduces the life span of the irrigation reservoir gradually. There are some soil and water conservation measures mainly stone bunds, check dams and enclosures but they are very minimal compared to the size and exposure of the of the catchment to land degradation.

Therefore an efficient and effective utilization of the existing land resources mainly of soil, water, and forest resource is very important by proposing soil and water conservation measures that improve the irrigational status of the site. Hence, area enclosures of degraded forest/bush lands accompanied with physical conservation measures such as stone bunds, check dams thereby reducing transportation of sediments to the proposed scheme reservoir.



## **4.5 Socio-Economic Environment**

The Socio-economic baseline conditions of the project area have been studied by collecting secondary data from regional, woreda and DA offices, and previous studies and collecting primary data through visual observations and interviews of key informants. Detailed description of the socio-economic features of the project area is given in a separate Socio-economic Study Report. The description given in this partial ESIA Report mainly focuses on the issues which are most relevant for the environmental and social impact analysis.

### **4.5.1 Administrative Structure**

The proposed Irrigation Project is situated in SE Zone of the Tigray NRS, Enderta woreda. The woreda is composed of 17 Tabyas of which Mahbere Genet Tabya is the areas where the project site is specifically situated.

### **4.5.2 Project area Population and Beneficiers**

Based on the official data obtained from the wereda finance and development office the total population of the project area is 7205 of this the male population constitutes 51% and the remaining 49% shared by female population thus a fair sex ratio composition is depicts which will play its vital role in the equal participation and benefit of both gender from the proposed irrigation development technology.

According to the data from socio economic feasibility studies the proposed irrigated land of the project command is owned by 76 household as a result this number of HH will be directly benefited from the project.

**Table 4.5-1** Population profile of the project area

Study area	Total population	Population by sex		Total number Of House Holds	Average Family Size
		Male	Female		
Enderta woreda	125739	-	-	36347	4.00
Mahbere Genet	7205	1137	549	1686	5.00

**Source:** FDO of wereda , 2017.

### 4.5.3 Economy

According to this study, made by, the predominant means of living for the population of project Woreda including the project area is mixed farming. It is estimated that about 99 % of the population of the woreda earn its livelihood from mixed agriculture. It comprises investment and subsistence agriculture in which pulse crop and subsistence crop production is predominant, and livestock husbandry is intimately integrated with crop production. Whereas the community of the project area earns its livelihood income merely from mixed farming.

Crop production is manly based on rain-fed farming with some irrigation practices mainly around the highland plateau and extensive lowland plains of Misrar teli and Gereb Giba River near the select project site. According to the household survey results, the major livelihoods means depend on crop production as primary source of income are: crop production, animal husbandry, and trade in their respective order. The major crops cultivated in the proposed irrigation area are sesame, sorghum cotton, finger millet in rain fed areas and various vegetables such as onions, tomato and lettuce and cabbages in irrigable areas. Major fruits grown in the irrigation areas include: banana, mango, lemon, orange, and papaya. As indicated earlier, livestock plays essential roles in the rural economy. In general, farm land accounts for 1855 ha, in the project area.

### ❖ Livestock

The dominant livestock includes: cattle, goats, sheep, and poultry, and camel, donkey and bee colonies. Donkey and horses are the main transport means in transporting farm product from farm to house to town center for marketing and water for domestic house hold use. In the project, livestock is one of the important livelihood sources of the woreda including the project area.

#### 4.5.4 Crop production in the project area

Crop production in the study area is achieved using both in rain fed and irrigable lands as discussed below.

##### 4.5.4.1 Major crops grown on rain fed farms of the project area

The project area, as the result of land degradation and shortage of rainfall the production system is unimodal or seasonal agricultural production with a very low yield per unit area. The main Agricultural constraint of the area are less and erratic distribution of rainfall together with less fertility of soil. There is good experience of farmers on traditional diversion irrigation on the side-line of the river that develops vegetables and perennial crops. The farming system of the area, like many other parts of Tigray, is mixed farming majority of the farmers involves in both crop production and animal husbandry and this is the major source of economy of the farmer. The crop production system is mainly rain fed and the animal husbandry is also uncontrolled/ free-grazing. The most important crops produced in the area are cereals mainly Sorghum, Maize, Teff, and Millet. When there is ample rainfall distribution with time most of the land is covered by Sorghum, Millet and maize, in which farmers are used for different local consumptions like food and Tela, when the rainfall starts late most of the land is covered by Teff which is early maturing crop and can easily grow with little moisture. Therefore, the percent coverage of those crops depends on the rainfall distribution of the area.

**Table 4.5-2 Major crops grown in rain fed agriculture**

S/n	Crop type	Coverage in %	Range Yield In quintals/ha
1	Barley	32	10-14
2	Wheat	30	8-12
3	Hannfets ( Wheat + barely)	15	8-10
4	Teff	10	4-6
5	Maize	6	12-16
6	Sorghum	4	14-18
7	Finger Millet	1	6-9
8	Others	2	-

Source: Agronomy reports of the project 2017

#### 4.5.4.2 Irrigation crop production

The command area is located around Misrar Teli River, with production primarily for household utility purpose. Farmers in the locality practice traditional irrigation by diverting river water through gravity and pumping . This means small holder farmers would be able to cultivate 2 times a year in both the dry and wet cropping seasons. The area is covered with vegetable and fruit trees, mixed crop and tree (agro forestry practices). The major vegetables and fruits growing in the study area are (onion, tomato) and (Mango, papaya) respectively. The total land being irrigated in the project area is estimated to be 205 ha.

#### 4.5.4.3 Soil Fertility Management and use of agro-chemicals

According to agronomy study report of this project, manuring, fertilization and compost making and fallowing are some of the common soil fertility management practices in the area. For improvement in crop productivity and production, the adoption of suitable agronomic technologies for soil nutrient management and crop production is the key factor.

in both wet and dry season there is very low fertilizer, manure and compost application as well as unbalanced nutrient application, the finding reveals that even if a lot of efforts are done to convince farmers to utilize chemical fertilizers most farmers do not use fertilizer in its optimum levels due to high price of fertilizers and lack of fertilizer demonstration in the area is resulting in exhaustion of plant nutrient and decreasing of crop productivity.

From this, it can be realized that the present use of agrochemicals is very limited; however, with the promotion of irrigation this will increase and needs due attention in terms of environmental management.

Encouraging efforts are being carried out by the community and government extension system. However, there are problems that must be tackled. Among the major ones, some include:

- Inadequate market infrastructure and linkage to absorb the products in time. The market is limited to the locality and neighboring towns.
- Lack of preservation facilities for perishable horticultural crops in the warm climate of the area.
- Shortage of pesticides and improved horticultural seed varieties. The existing supply is inadequate. When purchased from traders, it is expensive and of low quality.

#### **4.6 Educational status of the woreda and the project area**

Education is the main determining factor for human development and is one of the pillars where any development effort should pay attention. It is a means to sustain and accelerate over all development endeavors in a country and it has a direct effect on individual productivity and earnings. According to the Woreda Education Office, there are a total of 2 schools including elementary, complete elementary and first cycle primary schools in 2017 EFY in the project area.

The schools are serving for a total about 2462 students, among which, 53% are male and 47% are female students. There are about 2 schools with the average educational coverage of above 95%.

**Table 4.5-3** schools in the project kebele, 2017

School name	Education level	No of Students'		Share in %
		<i>Male</i>	<i>Female</i>	
Romanat	1-8	1010	912	<b>78</b>
Romanat	9-10	300	240	<b>22</b>
<b>Total</b>		<b>1310</b>	<b>1152</b>	<b>100%</b>

#### 4.7 Public Health Status

Health status of the woreda including the project area is assessed on the information obtained from the Woreda Health Office and Romanat health center. There is relatively better health care service in the study area by doing so 1 health center and 1 pharmacy are existing but great part of the population in the project area get better health service from its nearest city Mekelle at Ayder riferal and Mekelle hospital the opportunity to access private health service is great much. But still there are various constraints like in adequate access to medication, lack of health professionals and limited laboratory services which are aggravating to the poor health condition in the project area. As the statistical data from romanat health center show the three most common diseases in the project area i.e Diarrhea non blood, Acute Febrile Illness and Helminthiasis shared 35% of the total illness in the project area.

**Table 4.5-4 Top 10 Diseases in the project area ,2017**

<i>ID</i>	<i>Type of diseases</i>	<i>No. of patients</i>	<i>Share in %</i>
1	Diarrhea non blood	1009	21
2	Acute Febrile Illnesses	687	14
3	Helminthiasis	488	10
4	Malaria Pf	477	10
5	Malaria pv	477	10
6	Infection of the skin	433	9
7	Pneumonia	408	8
8	Acute upper respiratory infection	337	7
9	Trauma	276	6
10	Other or unspecified infections and parasitic Diseases	271	6
<b>Total</b>		<b>34490</b>	<b>100%</b>

Source: Romant health centre, 2017

#### **4.8 Potable Water supply of the project area**

Inadequacy of safe drinking water supply is among the major problems of the population in the woreda and command area. The villages in the command area have not fair coverage of potable water sources including shallow wells, spring development and Deep wells. Totally there are some 6 water points supplied from the above mention three major sources. The potable water coverage for the project target area mainly that of the project Tabya is about 53% even this coverage is lower than the middling coverage of the wereda which is some 65%.

According to informants, about two third of the existing water sources are functioning while the remaining one thirds are not functioning. Furthermore, the yield of these sources is decreasing in dry seasons. Hence, the yield becomes far below the demand of the population. This indicates the need for:

- recharging of water tables through catchment management;
- timely maintenance of the water sources; and
- Construction of additional water sources along with the increasing population in the command area.

In general, improvement of water supply that will commensurate with the improving life style of the community and increased population due to the proposed irrigation project has to be considered.

These problems have to be alleviated along with the planning and implementation of the irrigation project.

#### **4.9 Environmental Hygiene and sanitation status**

The current status of waste management, sanitation, water services and environmental management in the project area especially that of the kebele's administration settlement areas was investigated as part of the environmental assessment(EA).

The purpose is to develop a realistic picture of these aspects of environmental management in the municipal area. This will help with the formulation of action plans to address key issues but also create a record against which future developments in managing these issues can be measured. The information gathered during this phase was obtained by doing site visits and interviews as well as going through municipal records, The most common observation are that littering and illegal dumping occur in specific sites where by slum settlement areas are seen.

Since the project area a lately flourishing semi-town rural settlement a more complicated municipal and industrial waste is not as such as critical concern. However the major issues that should be raised mostly seen of source environmental pollution create poor hygiene and sanitation are mostly miss handling of agricultural and animal dung waste and poor facility of latrine, mismanagement of liquid waste.

Though agricultural and animal wastes are the major source of the environmental pollution in such semi rural area a good practice of reusing them as agricultural inputs by converting to organic fertilizer such as compost could bring a better opportunity in sustainable waste management to the local community.



**Table 4.5-5 Hygiene and sanitation profile**

<i>Kebelle</i>	<i>HH with permanent latrine</i>		<i>HH who have formal solid and liquid waste segregation</i>		<i>HH who permanently involve in health extension service</i>	
	HHN	Coverage in%	HHN	coverage in%	HHN	Share in%
<b>Mahbere</b>	780	46	261	15	1452	86
<b>Genet</b>						

Source: Romanat health centre, 2017

Based on the official data from the district extension health office presented in the above table relatively both liquid and waste management practices are very poor in the project area having coverage of some 15% even access to permanent latrine both at institutional and household level still very low having 46% coverage.

#### **4.10 Road Access and transportation**

The project area is easily accessible about 3 kms away from Mekelle city to the west direction alongside the main asphalt road to Tembien. Since this project site is located near the the capital city Tigray regional national state there have many access road facility in all directions hence , this will play a vital role in connecting easily the irrigation products from the project area to the most huge market in the city Mekelle.

#### **4.11 Market access**

Efficient marketing system is vital as the main source of motivation that leads to increased production. There are two types of markets in the study area. Those are mini market and major market centers. Mostly mini markets serve as a transaction among producers and buyers within the surrounding area. The number of market participants and product market exchange is limited. While

major markets serve as a transaction means among producers, consumers, and whole sellers. There is a huge and alternative future potential markets for the primary irrigation products in its nearby hence, this irrigation project site is located near the city of Mekelle the huge market potential will be for sure absorb all items produced at this irrigation site.

#### **4.12 Energy and electricity access**

The main source of energy in the project area is woody biomass. This is related to the availability of ample woody biomass resource in the project area. In addition, fossil fuels such as diesel and kerosene are used for operating grain mills and water pumps and for lighting respectively.

Electricity is also being expanded especially in the project tabia administration center called Romant where majority of the project area people expected to live in an organized semi towns settlement pattern..

#### **4.13 Settlement patterns of the project area**

The settlement pattern of the farmers in the project command area is that they settled in semi village situated near the main road which is far from the command area. The main canal passes through a hillside which is not cultivated It is a communal one. There is no displacement of house or land or any asset.

#### **4.14 Gender Aspect**

Gender issue become one of the most concern to such development project recently the equal participation of both men and women tend to be progressive in the project area especially women have relatively fair participation in all government programs a number of women headed household be able to possess cultivated land since the national and regional policy encourage women participation in all developmental aspects and have the right to own land. In relation to this project though the ratio women benefice is not equal to men all

women possess a cultivated land within the proposed project command will be equally benefited.

## **5 Stakeholder/ public consultation and disclosure**

### **5.1 Pubic consultations during the ESIA process**

Public and stakeholder consultation is useful for gathering environmental data, understanding likely impacts, determining community and individual preferences, selecting project alternatives and designing viable and sustainable mitigation and compensation plans. Consultation in the SESIA process is undertaken early before the project design, initial environmental assessment, and scoping phases of the study. The aim is to disseminate information to interested and affected parties, solicit their views and consult on sensitive issues of the irrigation scheme for Gereb fiyaye.

### **5.2 Government's Policy on Community Consultation and Participation**

Public consultation and community participation are entrenched in the Constitution of Ethiopia through Articles 43 and 44. Article 43 on the Right to Development states that "Nationals have the right to participate in national development and, in particular, to be consulted with respect to policies and projects affecting their community". Article 44 on Environment Rights states that "All persons have the right to live in a clean and healthy environment".

The overall objective of the Government is to involve communities in policy formulation and implementation at the local level. The Environmental Policy seeks to ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities, and to raise public awareness and promote understanding of the essential linkage between the environment and development.

### **5.3 IFAD Public consultation and disclosure policy (2010)**

IFAD's Policy on the Disclosure of Documents enables project design documents to be disclosed prior to the Executive Board session at which the project is to be considered. The Consultation also directed the Executive Board to review policy provisions with regard to the disclosure of previously undisclosed documents. All evaluation reports and documentation submitted to the Evaluation Committee are made available to the general public on the website of the IFAD Office of Evaluation (IOE), which is part of IFAD's corporate website. Project/program design documents are disclosed to the public in their original language prior to the Executive Board session at which the project/program is to be considered. The policy also discusses the process for disclosure of previously undisclosed documents, the language of disclosure and appeals.

### **5.4 The Consultation Process**

Basically the consultation process carried out was strongly aimed to: objectives of the public consultation process were as follows:

- ❖ To inform the public of the details of the proposed road construction project
- ❖ To ask local residents about problems they anticipate with the proposed project and how these can be overcome.
- ❖ To assess the view of relevant stakeholders and experts

The consultation process at the route selecting stage was an initial and shallow. More detail consultations are envisaged during the first phase assessment and scoping phases since the national Government and IFAD policy through the local administration, encourage community discussions before project implementation of development projects. The stakeholders for the proposed project were categorized as follows:

- ❖ Local community and elders

- ❖ Affected parties and households
- ❖ Kebele local government officials and experts
- ❖ Relevant wereda stakeholders
- ❖ Concerned wereda experts

### **5.5 Outcomes of discussion**

In order to achieve these objectives, key officials and experts at different administrative levels (woreda, and kebele levels) and community representatives were contacted and consulted. From 22-04-2010 E.C a FGD was conducted with Potentially Affected People (PAP) at the proposed scheme site similarly public meeting was held from 24-04- 2010 at kebele level at avenue of tabia muja administration center where by community and local government officials were participated After a detail project description, nature, future plan and its environmental and social consequences was briefly discussed to participants by the study team. An open discussion and question and answer session as followed to reach in a consensus. Accordingly the following results have come about.

- ❖ What mechanisms have proposed to minimized the potential impacts
- ❖ What is the capacity of the proposed irrigation project who and how will be benefited
- ❖ Opinion and their support to the project also detail discussed
- ❖ What are the expected irrigation technologies the community would be benefited from the project
- ❖ Major expected benefits of the project were also discussed in detail.

#### **Conclusions reached**

- The most controversial issue to deal with during the public consultation forum was the demand of the local community to increase the irrigation project capacity and harmonize the use right of

downstream some excluded and interrupted households due to the placing of the irrigation scheme in the proposed site.

- Though a number of questions and doubt was raised by the local community there was no community group or member who responded negatively for arrival and implementation of the project. Rather they strongly express their gratitude to the regional government for timely answered their long term demand for such irrigation project and will contributed their entire possible role for effective implementation of the project.

### **5.6 Public disclosure**

One of the mechanisms to disclose the project is conducting public consultation with the project affected people and relevant stakeholders. The public consultation is part of this partial ESIA study and it should be conducted at project screening and feasibility study phases of the project as we did above. Public consultations at these levels of the study are vital to disclose the type and nature of the project to directly affected people and to incorporate the public concerns, feelings, and advices in the design of the project. Projects designed through such a public participation are well recognized by the public and induce the feeling of ownership. Timely disclosure of the project to the public is also important to empower the community and involve them in a project implementation process. This eventually will make the project sustainable and socially acceptable.

After the completion of the study, the summarized reports of the project study can be disclosed to the public through local public meeting where by all concerned parties gather.

Conducting workshop with stakeholders on the draft report could also help to disclose the project for local government officials and interested experts. Distributing copies of draft and final reports to the public relation and wereda

EPO at the project Woreda could play an important role in disclosing the outcome of the project to the directly affected communities and concerned officials.



## **6 Anticipated Impacts and Mitigation Measures**

Irrigation development interventions like this project Misrar-Teli irrigation project may have their own positive and negative impacts. The effect could be on the quality and quantity of surface and groundwater resources and soils, landscape, biodiversity, land tenure, public health, etc. The overall environmental sustainability and precise environmental impacts of an irrigation scheme depend on the local environmental settings like water availability and water uses, the type of irrigation systems, and on the particular characteristics of irrigation practices used. Implementation of the proposed irrigation development is expected to bring a number of important socio-economic benefits to the beneficiary community. On the contrary, it will bring several negative environmental impacts also. Accordingly major anticipated impacts of the project are identified based on their degree of occurrence, significance level, and areal coverage using environmental assessment techniques like screening (impact rating) and assuming the overall project sustainability analysis approaches.

The main potential environmental impacts and their enhancement or mitigation measures are discussed below.

### **6.1 Major Potential Positive Impacts**

Implementation of the proposed earthen dam irrigation project is expected to bring a range of positive socio-economic and environmental impacts. The major potential positive impacts are briefly discussed below.

#### **6.1.1 Increase agricultural production**

The project will increase integrated, diversified and market oriented agricultural production. It also increases frequency of production using irrigation water doubling or tripling of crop production in a year. This will help increase production, productivity, and improve their income levels and benefits that will

support their livelihood. Thus, it will contribute to improve their living standards and harmonize the growing demand and price of agriculture products.

### **6.1.2 Reduce poverty and sustain food security**

This irrigation project believed to enhance the production capacity of the influenced area using a very sustainable and modern irrigation systems accordingly the subsistence and backward farming system of the project area will be advanced and production level per hectare will be boosted as a result the issue of food security will be sustained and poverty level between project benefits, local and regional scale will obviously reduced.

### **6.1.3 Creation of permanent and temporary Job opportunities**

Implementation of the project will provide substantial job opportunities for the unemployed people and for the people engaged in rain-fed agriculture during the idle periods. After the completion of the irrigation structure, it is expected that the land will be certified for the existing individual owners and extra land will be re allocated to landless members of the community who will engage more farmers and create job opportunities. Furthermore, after the completion of the project, each house hold/land owner may demand additional labor force to execute the irrigation activities which usually need labor and irrigation products that will enhance market link/exchange with urban community. These will also create additional job opportunities. In general, the irrigation project will help people increase production and generate income benefits that will support their livelihood by creating sustained and temporary job opportunities to the region in general and the community in particular.

### **6.1.4 Increase efficient use of water resource of the area**

Efficient use of water resources is crucial for the development of the locality socio-economic condition. Hence, expansion of the proposed irrigation project will enable to use available Misrar Teli River water resource efficiently and

effectively by placing this irrigation scheme, which otherwise flow freely for years.

#### **6.1.5 Improve efficient utilization of land resources**

Due to lack of access to modern irrigation technologies and farming systems a great portion of cultivated land in the project area remain less productive and idle for a couples of decades however using the timely advantage of this project the potential irrigated land which was utilizing in efficiently will be hopefully more productive and sustainably managed. The current use of the proposed land is partly grazing and partly rainfed agricultural land. Converting this land into irrigated farm would provide better production and efficient use of the land resource for the betterment of the region as well as for the local community. Accordingly a potential irrigated land assumed to be 100 ha would be under efficient land use.

#### **6.1.6 Improvement provision of social Infrastructure**

Among the potential benefits are improvements in physical and social infrastructure. This will rationally realized since the income level is expected to increase and the project area will also provide surplus production this will endowed the district to be among the development corridors of the wereda and the region too by far enrolment of basic social services will give priority by the regional government. Furthermore affordability of the project area community to better social and economic infrastructure would be attainable. This will improve accessibility to markets, health services, and safe drinking water supply, contributing for improved health status and standard of living of the local population.

#### **6.1.7 Enhance sustainable land management**

Implementing modern irrigation farm will improve soil fertility of the area through addition of organic matter and other fertilizers into the soil. Existing practices show that previously unfertile soils become fertile and productive

through soil conditioning and better management. Therefore, the same practice will be applied in the proposed irrigation area and soil condition would be improved. Typically the proposed irrigable land fall under this project which is estimated to be some 100 ha will be directly enhanced its fertility and bring sustainable land management practices too.

#### **6.1.8. Enhance aesthetic value and ecological balance**

The proposed irrigation area is currently covered by different type of species woody, bushes and shrubs. Under existing land use it would have less aesthetic value than it would have under irrigation. Developing the reservoir lake and irrigation development of the project would increase aesthetic and economic value of the area. Additionally the reservoir will create a wetland ecology which bring a new habitat opportunity for wild birds and fishes that boost by far the aesthetic value of the site. Similarly irrigation cultivation increase the availability sufficient grazing fodder for animals hence, this would improve and balanced the unproportional interaction between grazing land ecology and over grazing incident resulted by huge animal population pressure of the project target area.

#### **6.1.9. Bring better irrigation experience to local farmers**

As stated in the community meetings, some farmers do not know modern irrigation system. Therefore, the introduction of the project may capacitate the existing experience of the project area. Hence farmers attend modern irrigation systems and application of related technologies because of the project. Hence, trainings on irrigation extension techniques that will be provided to farmers will enhance their knowledge and skill.

#### **6.1.10. Promote commercialization of small holders**

The development of the irrigation scheme will increase varieties of products quantitatively and qualitatively that promote commercialization of the small holders in producing vegetables and high valued crops and Market oriented intensive livestock production.

The development of extensive irrigation farming will create raw materials for the development of small scale Agro-industry in the area, as extra production demands agro-industrial processing, which is part of realizing the objective of the rational economic policy for agricultural land industrialization and could enhance opportunity for the production of raw materials for small scale agro-industrial development.

#### **6.1.11 Promote gender equality**

Like other community members, both women and men will benefit from the agricultural transformation and employment opportunities of the project equally. Furthermore, women will be more benefited by running shops, bars and petty trades in the project area during the construction and operational periods. As a result, more women will likely be engaged in income-generating activities by selling local products and services to the workers. After the completion of the project, more and more agricultural and non-agricultural income generating opportunities will be created for women. Since women have equal access to land resources in the project area, they can be benefited from the irrigation scheme at large. These all will improve their living standards and of their family.

### **6.2 Negative Impacts on Physical Environment**

#### ***A. Pre-construction***

##### **6.2.1 Impacts related to construction of workers camp**

The establishment of construction camps usually causes some negative impacts on the local environment and the nearby communities. This impact will more serious typically if the workers camp would be established at **4 km** radius of the proposed irrigation scheme whereby permanent human settlement and massive natural wood land forest, cultivated land and religious center is available.

It is usually accompanied by some social and health problems that are primarily associated with the incoming population, including the construction crews. As a large proportion of the labor force might be employed from outside, the potential

problems include spreading of communicable diseases, deterioration of environmental sanitation, increased pressure on natural resources (forests & streams), water supply and services (mainly health facilities). The following summarizes the potential impacts of campsites:

- Land will be needed for construction of camps. The land that will be taken can be farmland or natural forest etc.
- Effluents discharged from campsites, spills of chemicals and pollutants from used fuel and oil as well as cement slag during construction can pose pollution risk to streams can intercepted.
- Unless campsites are suitably located, there could be a health hazard to existing settlements by transmission of diseases, particularly STDs.
- The campsites may have to share limited resources like water that could be already in short supply for the residents. Overloading of existing facilities (health care, potable water supply, garbage disposal facilities) could occur.
- The campsites could affect sensitive vegetation and wildlife areas unless properly located.

### **Mitigation measures**

- Negative environmental effects can be avoided or minimized by careful assemble of the camps. They should be located in an area so as to minimize the impacts on the local population, flora and fauna, water resources and drainage patterns. They should not be located at or near environmentally sensitive or vulnerable sites such as forests, settlements, watercourses, prime agricultural lands, religious sites, etc.
- All waste must be treated in a proper way and controlled by the construction supervisor. In addition, the camps should be dismantled and the areas rehabilitated as per the surrounding nature once construction is completed.

- Housing at the camps should be of sufficient quality to prevent disease-causing vectors, and adequate in number to prevent overcrowding. Furthermore, the campsites must have proper management and discipline.
- Select location of camp sites in collaboration with local authorities and concerned experts
- Establish construction campsite with appropriate and standard sanitation facilities including an imperviously lined septic tanks to reduce possible pollution impact on ground and surface water resources
- Dispose all the wastes from the camp properly in a designated and authorized places
- The contractor should take all necessary measures and precautions to avoid any nuisance or disturbance to inhabitants arising from the execution of works
- tree removal from any site shall only be done with the prior knowledge of environmental supervisor team and local forestry Department,
- Maintain trees in the camp to provide shed and to increase aesthetic value and Make workers aware about environmental sanitation and heal

#### *A. Construction phase*

##### **6.2.2 Impacts on Soils**

Soil is a fundamental element of the environment which supports a host of communities of living organisms, and is a main medium for agricultural production and other essential biochemical processes. Agricultural activities including irrigation schemes usually bring significant adverse effects on soils through destruction of its structure and enhancement of soil erosion. Related to the proposed Irrigation project, the activities to be involved in construction of the proposed diversion scheme, conveyance canals, irrigation infrastructures, access

roads and land preparation of the irrigable area are likely to remove the vegetation cover and destruct the topsoil and expose it to runoff water erosion.

These activities will increase the risk of soil erosion and physical impacts on soil structure. During project operation, soil erosion is likely to occur due to irrigation water flowing in furrows and irrigation fields in sloping areas. This may result in the degradation of the land.

Therefore, appropriate avoidance and mitigation measures should be implemented in order to prevent or minimize soil erosion and other adverse impacts on soils.

❖ *Mitigation measure*

- Concrete dissipation structures designed to slow fast-running storm water
- Diversion drains which avoid excessive concentration of flow;
- Lined drains for the sections with erosion-vulnerable soils and slopes,
- Provide check dams for reduce flooding
- Tree plantation for exposed land
- Land clearance should be restricted to what is absolutely necessary
- Rehabilitating borrow and quarry areas to a natural contour,
- Cut-off topsoil from the site and selected material sites should be preserved for re-use on embankment slopes and for re-filling of borrow and quarry sites.

### **6.2.3 Impacts due to Exploitation of Construction Materials**

Irrigation infrastructures and access roads will require the extraction and use of quite large quantities of various construction materials including selected (borrow) materials, natural gravel, crushed stone/aggregates, and sand. The location of quarries, borrow pits and access roads to those sites, and their extent and the actual methods of operation should remain safe. As the material geology study about 0.55 ha new land is selected for construction material extraction hence, the landscape will be modified and prone to erosion.



The principal environmental concerns related to extraction and haulage of quarry and borrow materials include the following:

- Impacts on visual quality of the landscape including scarring on working faces,
- Air pollution mainly due to dust raised by trucks transporting materials,
- Deep pits may be developed which are a safety hazard to people and livestock, Especially if they fill with water during the wet season and become breeding Grounds for insect disease vectors, and
- increased soil erosion and compaction due to construction and operation of access roads to borrow pits and quarries.

❖ **Mitigation Measures**

- Select quarry and borrow sites far from settlement and environmentally sensitive areas and get approval from Engineer and local authorities before exploiting
- Do not select quarry and borrow sites near and at river bed and other water supply sources
- Do not locate quarry and borrow sites in a dense forest areas
- Rehabilitate all quarries and borrow sites and access roads after the completion of the road construction works
- Maintain detour canal route within the ROW as much as possible
- List all the tree species found in the proposed quarry sites, borrow areas and detour roads and finally re plant the removed one
- Preserve top soils for reuse to refill borrow sites and quarry areas and Do not mix top soil with base soil
- After completion of work, reinstate or refill borrow and quarry sites with the stockpiled soil
- Level by spreading the top soil uniformly over the surface
- After reinstating, plant appropriate tree species (indigenous trees) or grasses to recover the original vegetation and to improve the biodiversity and aesthetic value of these sites

- Provide proper drainage to avoid storage of water in quarry and borrow sites to reduce malarial out break through reduction of mosquito breeding sites
- The land taken for selected construction materials should be reinstated to productive state when construction is completed by removing the applied selected/foreign material, loosening compacted materials and covering with top soils

#### **6.2.4 Impacts on Natural Vegetation**

The project activities that is likely to affect the natural vegetation and the terrestrial habitats include diversion weir foundation construction, land clearing and leveling for the command area, construction of the conveyance canals, irrigation infrastructures (canals, drains and farm roads) and access roads, quarrying for construction materials, establishment of campsites. The largest damages may be caused by the clearance of vegetation for dam construction and leveling for irrigation in command area. Most of the natural vegetation of the project impact areas (mainly irrigable area and reservoir site) is modified by human activities including cultivation, settlements, and livestock grazing. Moreover, there are narrow strips of riverian forests/woodlands or isolated bigger trees along the seasonal rivers and streams that drain through the command area. Regarding the command area, most of the area designated as potential irrigable area is already under cultivation and grazing. However, there are plenty of remnant trees most of which are likely to be removed during construction of irrigation structures mainly that of irrigation canal installation.

##### **⇒ Mitigation Measure**

- ❖ To minimize the destruction on nearby plant species the new irrigation project should use the existing road alignments as much as possible and avoid directing road alignment and detour roads wherever there is

significant amount of natural vegetation, particularly where there are endangered tree species

- ❖ Confining clearing of vegetation to what is absolutely necessary.
- ❖ Replanting trees and shrubs in areas adjacent to the proposed reservoir, canals and at areas affected due to operation of quarries and borrow pits. Indigenous and exotic species which are environmentally friendly and adapted to the agro-ecology of the areas are proposed.
- ❖ Providing a training and awareness raising programme for people involving in constructing, especially the operators of heavy equipment, so that they are familiarized with some key principles for conserving vegetation on the road sides and near quarry and borrow sites.
- ❖ Proper sitting of construction camps and facilities i.e. not at or near areas of conservation worthy vegetation, and controlling cutting of vegetation by the construction work force.
- ❖ Controlling encroachment into conservation-worthy areas and the over-cutting of the vegetation due to activities induced by the irrigation infrastructure .
- ❖ Establish a nursery at the project area to propagate and plant indigenous and endangered tree species in areas adjacent to the scheme and at areas affected due to operation of quarries and borrow pits.

### **6.2.5 Loss of private farm land**

According to the design study results, there is acquiring of farm land which owned by 7 farmers is being acquired for main canal and weir foundation purpose. Though the cumulative effect seems significant the ratio of land to be acquired from a single HH is very small which is below the compensation standard of land holding in the region. Also their homestead is far away from the reservoir area, no housing is affected by the project, hence no need of resettlement as the resources owned by the community are safe.

#### **⇒ Mitigation measure**

- ❖ Prior to any land acquisition consult affected households and ask for their view
- ❖ Reduce unwanted land loss due to main canal right of way detoure
- ❖ Minimize main canal width in order to reduce private land loss
- ❖ Re align main canal route at less suitable and bare land
- ❖ Make agreement over the sustainable project benefit that will compensate the temporary land loss
- ❖ Avoid irrigation structures crossing over project un benefited households land holdings to avoid the potential controversy

### **6.2.7 Public health concern**

Project construction period will create job opportunities attracting labor force from within and outside the area. This new influx will change the existing population structure in number, age, and health history. The main effects will be increased exposure of workers and their families to locally endemic diseases such as malaria through contact with insect vectors. Among water related vector-borne diseases, malaria, and bilharzias are the major public health concerns during the operation of the irrigation project. The risk of malaria will change from being seasonal to becoming perennial. The increase will result from creation

of vector breeding habitats along the temporary reservoirs and irrigation canals as well as within the irrigation fields. As reservoir water drawdown, shallow water points or pools can be formed in areas with flatter or gentle topography. Those sites will certainly become favorable breeding sites for vectors that transmit the disease to the communities living particularly within 1 km distance from the reservoir.

❖ **Mitigation Actions**

- Do not induce malaria out break by creating temporary & permanent water holding areas which favor mosquito breeding
- Use chemically treated mosquito nets in times of malaria out break and provide a clinic or medical facilities at the construction camp
- Restore borrow pits and quarry areas to minimize breeding sites for mosquito
- Minimize dust emission by watering the road during construction
- Store any explosives and chemicals in a safe place and make notification during blasting activities
- Provide safe water supply & appropriate waste disposal facilities including the provision of sanitary latrines in the construction camp
- Avoid stagnation of the irrigation water in the canals through undertaking regular cleaning of drainage systems
- During planning stage, design the intake structures that can avoid water logging problems in the irrigable site.

**6.2.8 Public and occupational Safety Issues**

The possible public and environmental safety concerns are related to accident risks from operation of construction vehicles and equipment in that, there will be high volume of vehicular traffic and operation of equipment, and commensurately these may result in increased safety hazards for the project workers, local communities and animals. In addition, deep borrow pits and

quarries may create safety problems especially to animals that may use those areas for grazing or they may be attracted by water collected in the pits.

#### **Mitigation measures**

- ❖ Set appropriate schedule and parking danger zone when massive explosive and excavation earth works
- ❖ Store any explosives and chemicals in a safe place and make notification during blasting activities
- ❖ Distribute goggles, helmets and other masks for the workers who directly involved in explosives, stone crashing and other similar activities,
- ❖ Minimize dust emission by watering while access road upgrading and construction
- ❖ Provide first-aid and clinics in the work places and main construction camp

## **B. Operation phase**

### **6.2.9 Climate risk Potential**

Though the contribution of this irrigation project to enhance the rain fall depend agriculture system in the project area and help to bring socio-economic progress of the community is promising due to the global climate change incident and local climate fluctuation its sustainability could intervened.

This irrigation development project will expect to enhance the low productive nature and subsistence farming system experiencing by the target community in the project area and believed to be among the best climate change adaptation mechanisms and emergency responses for drought incident to the contrary it could unexpectedly prone to climate change and weather variability due to the recent climate risk factors at global, national and regional level. Unless a climate risk and vulnerability early consider at the design phase and an integrated emergency response plan is developed the overall project sustainability could be unattained. An extreme weather events would resulted by low stream flow, crop failure , diseases expansion , drought and damaging floods this by far would put its impact on the scheme reservoir capacity and land productivity which could directly vulnerable the project community to reduce their income and affect their livelihood standard.

As a result unless a possible opportunities to strengthen climate-resilient and adaptation mechanisms early at least prepared at project level the expected benefit of the target group could be questionable and impossible

#### **❖ Mitigation Actions**

- Improve the knowledge project target community to climate risk incident and its adaptation mechanisms
- off river reservoir capacity enhancement should be consider during design
- An integrated watershed management strategy should be applied at scheme level

- Design and install water harvesting techniques to capture run off
- Promoting long term climate risk adaptive agronomic practice measures should be early designed
- Recommend drought resistance and less vulnerable crops
- Enhance efficient water use strategies and control water loss and excess use
- Farmers should prepared alternative source of irrigation water at farm field level like ground water , traditional spate and temporary reservoir for emergency response
- In case of unexpected drought incident farmers should advice to introduce water saving irrigation technologies like drip irrigation.
- Fast growing crops , fruits which are economically viable and less vulnerable to climate risk should be part of the integrated irrigation system

#### **6.2.10 Hinder livestock movement**

The installation of the irrigation canal would interrupt the movement patterns of the livestock as they seek to graze and access to water. The establishment of farms in the area could go a long way in hindering the free movement of domestic animals thereby precipitating the occurrence of man and livestock conflict especially if animals are grazed in the farms. There is also potential for blocking of animal transport routes in the area by blocking the pathways through which the animals access water from the river and also the seasonal movement agriculture products through animal back.

The conversion of more land into predominantly irrigated land could reduce the movement of animals to the available pasture grounds for families keeping livestock that roam freely in the land. This could lead to conflict between irrigating farmers and those keeping livestock. Similarly some surface crossing



canals would hinder the foot path of human and animals especially in very crowded marketing day. Thus, unless the availability of animal and human crossing foot path is early incorporated in the overall project design phase not only hinder the foot path unexpected damage could rely on some part irrigation canal due to animal and human collision or deliberate action for route access.

❖ *Mitigation Measure*

- The design team should incorporate animal foot path route within the main and secondary irrigation canal system
- A best alternative canal route which avoid the hindering of animal foot path must early consider during design phase
- A surface crossing at main pedestrian route must realigned or realigned as closed
- Avoid canal crossing in main grazing land and water sources for animal
- When the main canal is designed to traverse main animal and human path is should closed concrete wall to enable animal crossing

#### **6.2.11 Irrigation water quality concern**

Since the upper stream of the proposed scheme site was suspected for municipal and industrial waste pollution and some saline, nitrate and phosphate minerals nutrients concentration a diversified random sample was picked in order to verify the water quality standard of the project in five main points. Accordingly the final result shows a low to moderate allowable status of according to FAO standard for this reason crops should be selected and prioritized based on the tolerable nature to the existing soil and water nutrient concentration.

River water sample measurement results indicated that the presence of **moderate TDS and salinity**, the quality of water does not seem to have much negative impacts on the irrigation use, based on field visits and interactions with local farmers, they are producing varieties of vegetables and fruits with no

problem related to water quality. So, selection of appropriate crop varieties that favor to moderate nutrients and salinity concentration would recommend.

### **Mitigation Measure**

- Suitable crops which can tolerate the measured nutrient concentration of the water should be selected
- To crosscheck the of measured values seasonal fluctuation a periodic water quality assessment should be done specially during rainy season
- A proper irrigation water management should be applied to control unwanted soil water nutrient and excess salinity concentration

### **6.2.12 Agrochemical pollution and contamination Incidents**

Modern irrigation development demands the utilization of various kinds of agrochemical inputs in order to improve the production status of the previously low productive land though the economic return is clear and unrefined excess use and improper management of such toxic chemicals could by far affect water bodies around the command area and the downstream.

The farmers in the project area have a trend of utilizing agricultural inputs particularly some pesticides to protect crops from insects. Such chemical inputs may be more utilized with the intensification of agriculture using the proposed irrigation scheme. The active ingredients of the chemicals will either be adsorbed onto soil particles, or break down at various rates maintaining their toxicity. When this transported through run-off to nearby watercourses, can cause contamination of surface and ground water if not well managed.

### **Mitigation Measure**

- ❖ Apply environment friendly agro-chemicals which are less toxic to habitats and human
- ❖ Manage excess use of chemicals as to avoid risk of human and stream contamination
- ❖ Follow scientific irrigation management practices

- ❖ Appreciate less toxic local farmers anti pests and weed innovations
- ❖ Remove weeds early and manually before crop maturity stage as to reduce excess use of chemicals
- ❖ Control over flooding and releasing of polluted irrigation water from farm fields
- ❖ Use PPE during spraying
- ❖ Establish a minimum buffer zone (30-50 meter) between the command area and the river.
- ❖ Apply Integrated Pest Management than relying on the use of chemicals.
- ❖ Encourage the irrigation users to utilize more of organic fertilizers( compost, manure, and the like

#### **6.2.13 Sedimentation risk from upper catchment**

The most serious issue of this site would be its upper catchment instability especially due to massive construction materials extraction since the catchment is close to the fast growing city of Mekelle. Great part of the upper catchment the project area is highly influenced by human and animal interruption for many years in addition to this the steeply and undulated topography with very erodible soil texture i.e clay and silt loam is highly prone to erosion and sedimentation which will later affect the sustainability of the irrigation scheme. Upstream erosion may result in the delivery of fertile sediments to proposed irrigation project areas. However, this gain is a measure of the loss of fertility of upstream eroded lands. A major negative impact of erosion and the associated transport of soil particles is the sedimentation of cultivated land and abstraction points downstream, such as proposed intakes irrigation scheme. for intakes and irrigation canals are often the major annual maintenance cost on irrigation schemes. The increased sediment load is likely to change the river morphology which, together with the increased turbidity, will affect the downstream ecology. Similarly the catchments adjacent to the command area are low productivity and significant surface erosion. Considerable area in the upper part of the catchment

site (where intake flows are mostly generated) is covered by vegetation. The nature of slope (steep slopes) aggravates the erosion rate and sediment load in the project command area significantly.

### **Mitigation Measure**

- The project owner shall protect all areas susceptible to erosion and shall take measures to the activities that aggravate erosion. The project shall not allow erosion to develop on a large scale before effecting repairs and erosion damages shall be maintained as soon as possible.
- Implement erosion control techniques which disperse erosive energy and avoid concentrating it. For example, providing good vegetative cover will disperse the energy of rain drops and contour drainage will slow down surface runoff.
- Apply effective upstream slope stabilization during the dry season to protect erosion that leads to silting of canals (watershed management as a whole).
- Tree planting and soil & water conservation activities in the catchment should be strengthen
- Dispose the spoil soils which are dug up for canal construction on the lands which have lowest value/gully treatment
- Providing drainage systems along the canals that discharge the runoff to the natural water way
- Construct Gabion structure and retaining wall, cut off drains that diverts the runoff from upper catchments to the natural water way can reduce the flood hazard on scheme and also in the command site.

- Similarly, rehabilitation process or proper forestation will help in reducing soil erosion from quarry sites. Besides, direct seeding with grass or herbaceous plants would be ideal in those borrow or disturbed areas.
- Avoid over flooding through managing the water flow rate and velocities: The design of the irrigation canals should not be just vertically or down ward slope canals so as to control the volume and velocity of water in the canal.

#### **D. Decommission ( Post operation)**

##### **6.2.14 Deterioration of Scenic Quality (impact on aesthetic value)**

Irrigation development projects like this Misrar teli comprises natural environment disturbing activities like: Clearing of vegetation, excavation, and pavement of access roads for transportation of construction materials may lead to poor scenic conditions (loss of aesthetic value). Spoil disposal areas, waste soil, and salvages could create negative visual impacts unless properly managed. Therefore, spoil disposal sites should be located as far as possible in unproductive land with preference being given to back filling quarry or borrow sites, deformed landscape which has been disturbed by the construction process and finally it has to be leveled and grassed.

Such impacts will frequently appear and should give attention at the canal route section and its adjacent area and proposed quarry sites and around workers camp site.

#### **❖ Mitigation measures**

- Dispose solid as well as liquid wastes properly in a designated place
- Re- grade borrow and quarry sites and plant trees, preferably indigenous trees
- Re -grade canal route side cuts and level them
- Reclaim created gullies and borrow pits

- Locate spoil disposal site in unproductive land or use it to fill borrow and quarry sites
- Level any spoil disposal site & grass them
- Retain excavated weir foundation and reservoir abetments using gabion retaining wall to protect continuous landslide and gully erosion incidents.

### 6.3 Eligibility and Significance of Potential Impacts

The type and expected duration of occurrence, magnitude, and significance of the identified environmental and social impacts are presented in Table 10 below *based on the IFAD screening checklist for irrigation projects.*

**Table 6-1** Eligibility Status of the project (As per IFAD parameters)

<i>Will the proposed project result</i>	<i>Yes</i>	<i>No</i>	<i>Remarks</i>
<i>Loss of natural habitats, biodiversity and/or environmental services provided by natural ecosystem – for example natural primary forest or significant areas of wetlands</i>		✓	<i>There is no sensitive and highly significant ecological and social adverse impact hinder this project as per the national and international environmental regulations and conventions</i>
<i>Surface water or ground water based development where it is believed that significant depletion due to climate change or overutilization has occurred</i>		✓	
<i>Risk of destruction and pollution as a result of climatic (geographical hazards , storms , flooding , landslides and earthquake</i>		✓	
<i>Conversion and loss of important nationally recognized physical cultural resource or world heritage site</i>		✓	
<i>Significant social adverse impacts on indigenous group</i>		✓	
<i>High probability to have physical resettlement or economic displacement i.e 50 households</i>		✓	
<i>Development of large-scale irrigation schemes &gt; 3000 ha</i>		✓	

**Table 6-2 Summary of Identified Potential Environmental and Social Impacts**

<i>Potential adverse impacts</i>	<i>Impact level rating</i>					<i>Significance level</i>
	<i>none</i>	<i>low</i>	<i>Medium</i>	<i>high</i>	<i>unknown</i>	
<i>Significance deforestation resulting in Loss of biodiversity</i>		✓				<i>Low significance</i>
<i>Clearance of woodlands, shrub land, and grass land</i>		✓				<i>Low significance</i>
<i>Dispute between down and upper stream users over water use right</i>			✓			<i>Medium significance</i>
<i>Disturbance of wildlife habitats or wildlife population</i>	✓					<i>Low significance</i>
<i>Disrupt ecologically sensitive areas</i>	✓					<i>Low significance</i>
<i>Disturbance to cultural or religious site</i>	✓					<i>Low significance</i>
<i>Land acquisition and loss of assets</i>		✓				<i>Low significance</i>
<i>Hindered livestock to access pasture, grazing areas and water source</i>	✓					<i>Low significance</i>
<i>Increase water logging and soil salinity due to inefficient watering saline irrigation water and soil salinity</i>		✓				<i>Low significance</i>
<i>Risk of vector born diseases due to standing water at quarry water storage structures and canals</i>		✓				<i>Low significance</i>
<i>Increase use of pesticides and agrochemicals</i>		✓				<i>Low significance</i>

<i>Soil acidity due to increase and improper application of inorganic fertilizer</i>		✓				<i>Low significance</i>
<i>Deterioration of river water quality below irrigation project and contamination of local ground water (higher salinity , nutrients) affect fisheries and downstream users</i>		✓				<i>Low significance</i>
<i>Poor land use practice in catchment areas above dams/ reservoir resulting in increased siltation and loss of storage capacity</i>			✓			<i>Medium significance</i>
<i>Apply diversion or training of natural water bodies (e.g dykes , river training)</i>			✓			<i>Medium significance</i>

Source: IEE study for Misrar Teli project, 2017



## **7. Environmental Management and Monitoring Plan**

### **7.1 Environmental Management Plan**

The objective of the Environmental Management Plan (EMP) is provided in (Table 12). It links the impacts identified and mitigation measures proposed in the partial ESIA report, responsibilities for implementation and monitoring. In addition, it provides cost estimates for measures which have cost implication

The Environmental & social management plan describes the possible actions that are required to be taken to ensure that the adverse impacts which have been identified are mitigated to the extent feasible or acceptable. Wherever adverse impacts cannot be, if any, mitigated compensation programs will be designed, and any environmental enhancement activities required to offset or to minimize those impacts. The involvement of communities and various sectors integration with different environmental management responsibility and hierarchical level is very essential so as to manage the plan effectively and efficiently. Hence, all concerned regional, woreda and kebele institution should work in collaboration. To this effect EMPs have already been prepared for the selected significance social and environmental adverse impacts recognized earlier.

- **Purpose of EMP as part of an ESIA**
  - ❖ Elimination or limitation of the impacts of a project on the environment to the lowest level
  - ❖ Compensation of unavoidable impacts on the environment
  - ❖ Definition of necessary monitoring requiremen

## **7.2 Institutional of responsibilities**

The Environmental Management Plan (EMP) is proposed to ensure sustainable development during operation of the proposed project. Hence, it needs proper Environmental Management Plan (EMP) to meet these objectives. The management action plan aims at controlling adverse impacts at the source level to the possible extent with the available and affordable technology followed by treatment measures before they are discharged. Various comprehensive mitigation measures are proposed in order to synchronize the economic and social development of the study area with the environmental protection of the region.

Socio-environmental management is concerned with implementation of the measures necessary to minimize or offset adverse socio-environmental impacts and to enhance beneficial impacts. Unless the mitigation and benefit enhancement measures identified in the SESIA are fully implemented, the prime function of ESIA, which is the safeguarding of the overall environment, would not be achieved. Hence in order to maintain the environment effectively and efficiently, socio-environmental management must be fully integrated with the overall project management effort at all levels, which itself should be aimed at providing a high level of quality control, leading to a project which is properly designed, constructed and functions efficiently throughout its life.

Both project management and socio-environmental management responsibilities are normally shared among several government and non-government organizations, each with specific executive responsibilities for particular aspects, which are exercised during the various stages of project preparation, implementation and subsequent operation and maintenance phases.

In the following section and in table 12 major socio-environmental management activities and responsible bodies for the execution of these activities are briefly described.

In this stage followed by monitoring, encompasses by practical steps and actions to control adverse environmental impacts during project implementation.

In order to make the program sustainable integration of environmental considerations for key development programs and projects is essential.

The project's potential adverse environmental impacts will be mitigated and its sustainability promoted by implementation of an Environmental Management Plan (EMP), prepared in accordance with the EPA's draft guidance on sectoral EMPs (EPA 2004). Accordingly the environmental management and monitoring plan (EMMP) of the **irrigation** project has been formulated using the following five-point approach:

- **Impact avoidance:** adjusting the project's design, construction, and operation methods so as to avoid predicted negative impacts.
- **Impact minimization:** where impacts cannot be avoided, implementing mitigation measures to reduce the impacts to insignificant levels.
- **Compensation:** where residual impacts remain significant after mitigation, arranging compensation in the form of, for example, comprehensive resettlement plans for persons affected by loss of land, assets, or livelihoods, or biodiversity offsets.
- **Sustainability measures:** where certain actions are required to ensure the project's success or avoid significant risks, identifying these.
- **Enhancement:** where additional actions could be taken giving high benefit at relatively low cost, identifying these.

All of the impact management plans in the construction phase can be implemented by a contractor while the supervision and monitoring of the implementation of these plans can be done by the client by assigning environmental inspector.

An environmental inspector has to ensure proper implementation of these activities and should submit report on the status of environmental management to the project owner, in this case, the TWRB.

During operation phase of the project implementation, the impact management plan would be handled by the project owner and contractor of the development Project. In order to avoid confusion and gap of responsibility in implementing the plan, detail environmental management activities would be identified and entities responsible to implement these activities would be specified in a bid document and in the contractual agreement.

To implement effectively the proposed socio-environmental mitigation and management activities the responsibilities are described at different phases of the project as follow.

#### ❖ Detailed Designing Phase

During the detailed design phase, the design consultant should incorporate all the recommended socio-environmental mitigation measures and enhancement measures which are recommended by the ESIA study to be included into the design, and including technical specifications in the bidding document for the prevention of adverse environmental effects.

#### ❖ Pre-Construction Phase

Prior to contractor mobilization and the commencement of construction, socio-environmental management should focus on:

- ❖ Ensuring that all government and funding agency (IFAD) requirements and procedures relating to ESIA are complied with,
- ❖ Ensuring that the tender and construction contract documents contain appropriate clauses to allow control of impacts arising from construction activities,

- ❖ Ensuring the proper implementation of land and property acquisition procedures including the payment of compensation.

#### ❖ **Construction Phase**

Most of the project socio-environmental management activities will be carried out during the construction phase, since it is at this time that most impacts can be expected to occur. The construction contractor will be fully responsible for implementing all the environmental mitigation measures included in the ESIA report, design, and technical specifications. On the other hand, construction supervisor should monitor impacts and the proper implementation of mitigation measures at the right time. The supervision team shall be fully responsible for ensuring that all the works will be carried out as per specifications and drawings, that the environmental impacts will be taken into consideration, and that good workmanship will be followed. The team should also be empowered to deal with infringements at the time and on the spot.

In order to discharge the responsibility of overseeing the EMP, the team of construction supervision consultant should contain an environmentalist/a sociologist. He/she will have executive responsibility for ensuring that all site socio-environmental management and monitoring aspects are dealt, promptly and properly. He/she will be responsible for establishing procedures and mechanisms for effective environmental management and monitoring and will ensure that these are fully incorporated and integrated with the overall construction supervision and monitoring framework. This aspect will cover matters such as the development of checklists of key points which will be monitored on a routine basis during construction and reporting mechanisms for ensuring that appropriate remedial action is taken.

The environmentalist/sociologist should also be responsible for reviewing and commenting on socio-environmental aspects of work plans prepared by the construction Contractor during the mobilization period, as well as in developing

site environmental management procedures etc, in collaboration with the assigned environmental management supervisor and other team members. He/she will also provide advice and assistance to the supervising Engineers and constructions as and when required, on all aspects of socio-environmental management aspects.

Table 6-3 Environmental Management Plan

Project phase	Potential impacts	Mitigation Measures	Parameters	Unit	Frequency	Required budget	Responsible Body
<i>Pre-construction</i>	Impacts from Construction workers Camp	<ul style="list-style-type: none"> <li>➤ Careful locate the camps</li> <li>➤ Close not interaction with local community</li> <li>➤ Not remove private tree</li> <li>➤ Consult affected party</li> <li>➤ locate campsite with appropriate and standard sanitation facilities</li> <li>➤ treat waste properly</li> <li>➤ Minimize land take</li> <li>➤ Compensate for loss asset</li> </ul>	<ul style="list-style-type: none"> <li>- Latrine</li> <li>- Land fill</li> <li>- Shower room</li> <li>- Clean affected site</li> <li>- Restore the site to previous status</li> </ul>	Num  ha	<ul style="list-style-type: none"> <li>- 2</li> <li>- 1</li> <li>- 2</li> <li>- 2</li> </ul>	Part of the project running cost	Project owner and contractor
<i>Construction</i>	Soil erosion erosion and degradation	<ul style="list-style-type: none"> <li>➤ construction for dry season</li> <li>➤ Provide appropriate drainage</li> <li>➤ Refill the exposed or excavated</li> <li>➤ Minimize land clearing and disturbance</li> <li>➤ Apply erosion control</li> <li>➤ management to reduce erosion</li> <li>➤ Diversion drains</li> </ul>	<ul style="list-style-type: none"> <li>- Check dam</li> <li>- Drainage canal</li> <li>- Water fall wall</li> <li>- Retention wall</li> </ul>	Metr  Metr Metr	<ul style="list-style-type: none"> <li>- 10</li> <li>- 150</li> <li>- 13</li> <li>- 30</li> </ul>	175,000	Project owner and contractor
	Loss of natural	<ul style="list-style-type: none"> <li>➤ Avoid cutting indigenous trees</li> </ul>	- Saved tree				Project

vegataion and endangered species	<ul style="list-style-type: none"> <li>➤ Avoid excessive bush clearing</li> <li>➤ A forestation and reforestation</li> <li>➤ Follow previous alignment</li> <li>➤ Reduce canal dimension</li> <li>➤ Careful locate the camps</li> <li>➤ Aware project workers</li> </ul>	<ul style="list-style-type: none"> <li>-re planted tree</li> <li>-narrow canal alignment</li> <li>-proper camp site</li> </ul>	num	24 5,000	55,000	owner
Land degradation	<ul style="list-style-type: none"> <li>➤ Minimize side-cutting</li> <li>➤ Restore borrows sites</li> <li>➤ Replant and maintain vegetation</li> <li>➤ Distribute topsoil</li> <li>➤ Maintain degraded land</li> <li>➤ Refill the exposed land</li> </ul>	<ul style="list-style-type: none"> <li>- Traccing</li> <li>- Plantation</li> <li>- Soil refilled</li> </ul>	km Num M3	5 15,500 15,000	150,000	Project owner
Loss/acquiring of private	<ul style="list-style-type: none"> <li>➤ Minimize land loss</li> <li>➤ Revise canl route</li> <li>➤ Consult PAPS</li> <li>➤ Use existing road</li> </ul>	As per the mitigation	ha	- 3.5	Nil if the mitigation measure applied	Consultant Project owner and contractor
Public health concern	<ul style="list-style-type: none"> <li>➤ Implement awareness creation for local community</li> <li>➤ Provide primary health care</li> <li>➤ Provide first aid service</li> <li>➤ Provide clean water</li> <li>➤ Use mosquito net</li> </ul>	<ul style="list-style-type: none"> <li>- Health service</li> <li>- Clean water</li> <li>- Mosquito net</li> </ul>	Num M3 num	Month ly 10,000 30	Part of the project cost	Project owner and contractor
Occupational and workers saft	<ul style="list-style-type: none"> <li>➤ Carry out regular risk assessments</li> </ul>	-risk assessment	Num Code	<b>2</b>		



	issue	<ul style="list-style-type: none"> <li>➤ Apply national regulation</li> <li>➤ Establish a standard code of practice</li> <li>➤ Install fully equipped first Aid Kits</li> <li>➤ Provide adequate sanitation</li> <li>➤ Erect warning signs /bumps</li> <li>➤ Ensured workers</li> <li>➤ Provide injury and dust protective mask</li> <li>➤ Malaria diagnosis and treatment</li> </ul>	<ul style="list-style-type: none"> <li>- applied code</li> <li>- first aid kit</li> <li>- sanitation facility</li> <li>- warning signs</li> <li>- ensured workers</li> <li>- head mask</li> <li>- treated workers</li> </ul>	<ul style="list-style-type: none"> <li>Set num</li> <li>num</li> <li>num</li> <li>num</li> <li>num</li> <li>num</li> </ul>	<ul style="list-style-type: none"> <li>2</li> <li>5</li> <li>12</li> <li>30</li> <li>30</li> </ul>	120,000	Contractor and Project owner
Operation phase	Climate risk vulnerability	<ul style="list-style-type: none"> <li>➤ Apply effective moisture harvesting technologies</li> <li>➤ cultivate drought resistance crops</li> <li>➤ integrated catchment management</li> <li>➤ design alternative water source</li> <li>➤ reduce irrigation water loss</li> <li>➤ climate risk adaptive agronomic practices</li> </ul>	<ul style="list-style-type: none"> <li>- Suitable crops</li> <li>- Effective water use</li> <li>- Treated catchment</li> <li>- Water storage ponds</li> <li>- Pest and diseases controlling chemicals</li> </ul>	<ul style="list-style-type: none"> <li>- 76 ponds</li> <li>- 25 km2</li> <li>- 2 water use</li> <li>- association</li> </ul>	Annually	Part of the project cost	Contractor and Project owner
	Hider livestock	<ul style="list-style-type: none"> <li>➤ avoid canal on main animal</li> </ul>	<ul style="list-style-type: none"> <li>- constructed</li> </ul>	<ul style="list-style-type: none"> <li>- 15 m</li> </ul>	Constr	Part of the	Contractor

	movement	<ul style="list-style-type: none"> <li>➤ paths</li> <li>➤ design livestock path</li> <li>➤ use closed canals around major livestock paths</li> <li>➤ realign best canal route to reduce hindering</li> </ul>	<ul style="list-style-type: none"> <li>- path alternative canal route</li> </ul>	- 500 m	uction year	project cost	and Project Owner
	Irrigation water quality concern	<ul style="list-style-type: none"> <li>➤ Appropriate irrigation water management</li> <li>➤ Adhere to waste discharge regulations</li> <li>➤ Use suitable crops</li> <li>➤ Avoiding pollution of river</li> <li>➤ provide clean water</li> <li>➤ periodic water quality monitoring</li> <li>➤ prepare liquid waste collecting pit</li> </ul>	<ul style="list-style-type: none"> <li>- Suitable crops</li> <li>- Pit</li> <li>- Training</li> <li>- Water quality monitoring</li> </ul>	Every irrigating season	Annua lly	80,000	Consultant and Project owner
	Sedimentation effect from upper catchment	<ul style="list-style-type: none"> <li>➤ Catchment treatment and conservation measures</li> </ul>	-physical and biological conservation	hectare	<b>800</b>	140,000	Project owner
<i>Decommission</i>	Impact from left quarry site	<ul style="list-style-type: none"> <li>➤ Select proper quarry site</li> <li>➤ Locate quarry far from sensitive area</li> <li>➤ Preserve top soils for reuse to refill</li> <li>➤ Rehabilitate all quarries and borrow sites</li> </ul>	<ul style="list-style-type: none"> <li>- Use left soil</li> <li>- Re filled pit</li> <li>- Re planted site</li> <li>- Preserved quarry site</li> </ul>	M3 Num Hr	20,000 3 0.5	Part of the project cost	Project owner

		<ul style="list-style-type: none"> <li>➤ After reinstating, plant appropriate tree species</li> <li>➤ Preserve previous status of affected quarry site</li> </ul>			2		
	Scenic quality alteration	<ul style="list-style-type: none"> <li>➤ Re-plant vegetation to restore the natural appearance of the affected areas where feasible;</li> <li>➤ Stabilize slope of affected natural environment</li> <li>➤ Re-plant the reinstated borrow sites with appropriate plant species, mainly trees and shrubs</li> </ul>	<ul style="list-style-type: none"> <li>- Restored sites</li> <li>- Re planted natural environment</li> </ul>	Hr	1.25	Part of the project cost	Project owner and contractor
<b>Total Environmental management cost</b>			Environmental management and enhancing cost= <b>740,000</b>				
			Contingency (10%) = <b>74,000</b>				
			Overall environmental management cost= <b>814,000</b>				

### 7.3 Environmental monitoring plan

Implementation and follow up to check on the implementation of the terms and conditions of approval during the construction, operation phases to monitor the impacts of the project and the effectiveness of mitigation measures; to take any actions necessary to ameliorate problems; and as required, to undertake audit and evaluation to strengthen future ESIA application in procedural effective monitoring plan have prepared to implement throughout the project cycle.

The Monitoring allows the measures and conditions attached to project approval to be fine-tuned in the light of new information. The primary aim of monitoring is to provide information that will aid impact management and continually; to achieve a better understanding of cause effect relationship and to improve environmental assessment prediction and mitigation methods. When used systematically, it facilitates impact management, built continuity in to the environmental and social impact assessment process and help to optimize environmental benefits at each stage of the project development.

Environmental monitoring program has prepared for the proposed irrigation project for assessing the efficiency of environmental management plan implementation and to take correction measures in case of any alteration activity in the surrounding environment.

Monitoring of the project operations, i.e. the physical environment and public health in the vicinity of social and ecological management facility is an integrated part of the design, construction, and operation of the project.

The proposed monitoring program has these interrelated objectives.

- ❖ *To check the implementation and management of the various aspects require for impact mitigation*
- ❖ *To check how effective are the measures for mitigation and control adverse impacts*
- ❖ *In case some non-compliance further measures for rectification*

The main objective of environmental monitoring program is aimed such that there is not much of time lack between commencements of damage to environment mitigation measures to various environmental parameters that are being affected.

Due to this the result of monitoring activity by concerned officials and institutes can bring about and evaluate various correction measures:

- ❖ *Evaluate the extent and severity of environmental impacts against the proposed impacts*
- ❖ *Examine performance of environmental protection measures or compliance with pertinent rules and regulations*
- ❖ *Trends in impacts and Overall effectiveness of the project EMP*

Accordingly the responsible institute and authority, probably, the ministry of environment and forest, the regional and EPA and the correspondent wereda and local agents will easily monitor and evaluate the effective implementation of the mitigation parameters proposed during the environmental management plan and this can help both partners in coordinating for the environmental sounded project in the proposed area.

To do this we have clearly identified and quantified all the monitoring parameters and their corresponding implementing measures in a summarized tabular form; typically an monitoring plan which will contain subsidiary plans for the two broad tasks of (i) environmental and (ii) social management. These, in turn, may be broken down into further three phase i.e. preparation, construction and Operation phase monitoring Plan.

In this case, the EMMP of the project presents and includes on such plan, in the form of a stand-alone summarized tabular report: this will be structurally organized in the table 13 below:

**Table 6-4** Abstract of Environmental and Social Monitoring Plan

<b>Project phase</b>	<b>Potential impacts</b>	<b>Monitoring parameters</b>	<b>Monitoring system</b>	<b>Frequency</b>	<b>Required budget</b>	<b>Responsible body</b>
<i>Pre-construction</i>	Impacts from Construction workers Camp	<ul style="list-style-type: none"> <li>- Safely located camp site and restored to its previous status</li> <li>- Located site without acquiring private land</li> </ul>	<ul style="list-style-type: none"> <li>- Supervision</li> </ul>	<ul style="list-style-type: none"> <li>- Quarterly</li> </ul>	Part of the project running cost	Regional and wereda EPA
<i>Construction</i>	Soil erosion erosion and degradation	<ul style="list-style-type: none"> <li>- Effectively done soil and conservation activities</li> <li>- Structures applied for erosion control</li> <li>- Biologically conserved area</li> </ul>	<ul style="list-style-type: none"> <li>- On site observation</li> </ul>	<ul style="list-style-type: none"> <li>- Annually</li> </ul>	175,000	Regional and wereda EPA
	Loss of natural vegetation and endangered species	<ul style="list-style-type: none"> <li>➤ A reclaimed and replanted land within the project command area</li> <li>➤ Effective plantation activities</li> </ul>	<ul style="list-style-type: none"> <li>- Supervision</li> </ul>	Annually	55,000	Regional and wereda EPA
	Land degradation	<ul style="list-style-type: none"> <li>➤ Physically rehabilitation measures effectively done in affected command area like traced and gully reclaimed</li> </ul>	<ul style="list-style-type: none"> <li>- site observation</li> </ul>	Towice a year	150,000	Regional and wereda EPA
	Loss/acquiring	<ul style="list-style-type: none"> <li>➤ Acceptance and loyalty of PAPs towards the acquired</li> </ul>	Focus group discussion		Nil if the mitigation	Regional and wereda EPA

	of private	land by irrigation main canal	with PAPs	- Early before construction	measure applied	with land administration office
	Public health concern	Public health risk management activities	- Recording, inquire and observation	Towice a year	Part of the project cost	Regional and wereda EPA with health office
	Occupational and workers saft issue	➤ Activities done for workers safety protection and risk minimization	-risk assessment - observation and recording	Annually	120,000	Regional and wereda EPA with health office
<b>Operatio n phase</b>	Climate risk vulnerability	<ul style="list-style-type: none"> <li>➤ Allowable environmental release 25% the lean flow</li> <li>➤ Released down stream flow</li> <li>➤ Downstream Water quality assessment</li> </ul>	- Site visiting - Constructio n supervision	Annually	80,000	Regional and wereda EPA with TRWRB and office
	Sedimentation effect from upper catchment	➤ Catchment treatment rehabilitation measures done both physical and conservation measures	-catchment observation	Annually	140,000	Regional and wereda EPA with Regional and wereda natural resource department

<i>Decommission</i>	Impact from left quarry site	<ul style="list-style-type: none"> <li>➤ Reclaimed and rehabilitated previous project quarry site</li> </ul>	- Onsite observation	Annually	Part of the project cost	Regional and wereda EPA
	Scenic quality alteration	<ul style="list-style-type: none"> <li>➤ Re-plant vegetation to restore the natural appearance of the affected areas where feasible;</li> <li>➤ Stabilize slope of affected natural environment</li> <li>➤ Re-plant the reinstated borrow sites with appropriate plant species, mainly trees and shrubs</li> </ul>	- Onsite observation	Annually	Part of the project cost	Regional and wereda EPA
<b>Environmental and social monitoring cost</b>					<b>90,000 Birr</b>	
<b>Total Socio-Environmental management and monitoring cost</b>				<b>904,000 Birr</b>		



## 8. CONCLUSION AND RECOMMENDATIONS

### 8.1 Conclusion

According to the initial environmental evaluation prior to this small scale irrigation project, a great part of economic and social benefits to the other side, a number of environmental and social impacts which have a low rate of impact significance could be managed if the proposed mitigation actions are applied effectively. Due to this, a continuous partial ESIA is carried out, hence falling under category **B (schedule II)** in order to appraise the overall sustainability of the project.

Based on the findings of this Partial environmental social impact analysis and implementation of the Proposed **Misrar Teli** Irrigation Development Project, will result in a number of positive socio-economic impacts and negative environmental and social impacts. The main potential benefits include: improved varieties of agricultural production and productivity, reduction of food insecurity, provision of employment opportunities, improved social and physical infrastructure, and rising of living standards of the people in the irrigation command and surrounding areas, introduction of fish farming and eco-tourism, etc. Conversely, the construction and operation of the project will result in several adverse environmental and social impacts that can be mitigated and have low to moderate significance. The major adverse impacts are related to construction, operation and land preparation of the irrigation command area. Loss of farm land due to inundation by the main canal, land and soil degradation are encompassed in the project area, and public and environmental safety issues. But, in terms of socio-economy, this will be negated and converted into a positive effect by irrigated agriculture. Other important negative impacts include: soil erosion, deterioration of water quality due to improper use of agrochemicals, downstream effect due to excess irrigation water utilization, and increased public health risks from water-related diseases.

However, the negative impacts can be reduced to acceptable levels through integration of environmental mitigation measures in the design or planning and implementation of the project. Therefore, it can be concluded that there will be no severe or immitigable impacts that will prevent the implementation of the irrigation project provided that the recommended mitigation plan is properly implemented.

Regarding social acceptability, stakeholders and public consultations conducted at woreda and community levels revealed that a high acceptance of the proposed irrigation project. This is largely based on the expectations that there will be opportunities for substantial increase in agricultural production and employment for local people, and thus, increased income level and improved living standards. They believed that implementation of the proposed project would bring significant improvement in the socio-economic status of the community such benefits will significantly contribute to the overall economic development of the project area, the wereda and the region.

In order to have minimal and acceptable residual environmental and social impacts, and enhance the potential, a **total Environmental mitigation cost is estimated to be 814,000.00** and necessary follow up of their **effectiveness should be made through well planned monitoring programs with the cost of 90,000.00 Birr per the planned year and a total of Birr 904,000.00 for consecutive five years** by concerned stakeholders to have minimal and acceptable residual environmental and social impacts and enhance the potential benefits.

Finally, the project is found to be socially acceptable, economically feasible, and environmentally sustainable therefore relevant stakeholders, local government official fund source organization in this case (IFAD) should support the project realization and the cost of environmental management should early consider.

## 8.2 Recommendations

In order to have minimal and acceptable residual environmental and social impacts, and enhance the potential benefits, it is recommended that the proposed mitigation measures are properly implemented at the right time, and necessary follow up of their effectiveness is made through well planned monitoring program. In particular, the following mitigation measures or actions shall be given due attention and properly implemented by the concerned parties:

- Establishment of an efficient water application/management system to irrigation fields in order to prevent adverse soil modification like water-logging, and creation of mosquito and snail breeding sites.
- Application of proper handling and use of agro-chemicals according to accepted guidelines.
- Taking appropriate measures to minimize the negative effects green house gases related to climate change by applying environmental friendly irrigation practices.
- Use of environmentally friendly chemicals and biological control measures against pests and diseases.
- Establishment of a strong environmental management and vector control and educational programs to control the transmission of water related vector-borne and STD diseases including malaria, schistosomiasis and Sexually Transmitted Diseases including HIV/AIDS.
- It is important that these measures be implemented by allocating the necessary resources.
- Enhancing market oriented production system using production enhanced technologies that lead to agro-industrial development.
- Establishing a monitoring program for checking the critical parameters like water quality, relevant soil characteristics, groundwater level, water-logging, and disease vector breeding places.

- The commitments of the key stakeholders including the Bureau of Agriculture, Water Resources Bureau, Woreda and Kebele Administrations, Agriculture Offices, and Health Offices to implement the mitigation measures specified in the EMP and other necessary actions will be vital.
- It needs continuous people consultation and information disclosure in order to resolve timely arising problems.

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## 10. APPENDCES

### Appendix 1. Checklist for impact screening and project eligibility

#### Screening Checklists

Eligibility Screening

Scheme Name: Misrar Teli

Region: Tigray Zone: SE Woroda Endoketa Kebele: Moh/Girmit

Tier 1 Eligibility Screening Checklist

Will the Project/Scheme result in or involve:	YES	NO
Loss of critical natural habitats, biodiversity and/or environmental services provided by a natural ecosystem – for example natural primary forests or significant areas of wetlands		✓
Surface-water or groundwater-based development where it is believed that significant depletion due to climate change or overutilization has occurred	✓	✓
Risk of destruction and pollution as a result of climatic/geophysical hazards (storms, flooding, landslides, earthquakes)		✓
Conversion and loss of important nationally recognised physical cultural resources or a World Heritage Site		✓
Significant social adverse impacts on indigenous groups		✓
High probability to have physical resettlement or economic displacement - ie 50 households		✓
Development of a large-scale irrigation schemes >3000 ha		✓

Recommendation:

Scheme is not eligible and rejected

Reasons for rejection: \_\_\_\_\_

Scheme is eligible and approved

Eligibility Screening Done By:

- | Name                    | Signature   |
|-------------------------|---|
| 1 <u>Kahse Tsegay</u>   |  |
| 2 <u>Mohammed Nigus</u> |  |
| 3                       |   |
| 4                       |   |

WEPA (Woroda EPA)  
EWI



**Impact Rating Checklist**

Project Infrastructure	None	Low	Medium	High	Unknown
<b>Rural Access Road Construction Projects</b>		X			
Soil erosion and initiation of flooding, gully erosion, farm land degradation					
Loss of biodiversity through cut and fill activities					
Destruction of natural habitats and ecologically sensitive habitats					
Sediment loading in water sources and reservoirs					
Damage to cultural, religious and historical sites					
Excavation of quarry/borrow sites resulting in sediment loading in water sources, vector borne diseases, loss of productive land, and aesthetic impacts.					
Land acquisition, loss of property/assets and access to assets					
Others (specify)					
<b>Small Scale Irrigation Projects</b>					
Significant deforestation resulting in biodiversity loss		✓			
Clearing of woodlands/shrubland/bushland/grassland resulting in biodiversity loss		✓			
Competing claims for water and social tension between the upstream and downstream community			✓		
Disturbance to wildlife habitats or wildlife populations	✓				
Disrupt ecologically sensitive areas		✓			
Disturbance to cultural or religious sites		✓			
Land acquisition, loss of property/assets and access to assets		✓			
Hindered access for livestock to pasture, grazing areas and water sources		✓			
Water logging and increased soil salinity due to inefficient water application, saline irrigation water, and soil salinity			✓		
Risk of vector borne diseases due to standing water at quarry site, water storage			✓		





**Impact Rating Checklist**

Scheme Name: Misrar-Teli  
 Region: Tigray Zone: SE Woreda: awata Kebele: Mah/Genet

**Rating Methodology**

The significance of an impact is a function of the likelihood of it occurring and its consequence.

**Definitions of Consequence**

Consequence	A. Definition
No Impact / No change	<ul style="list-style-type: none"> <li>No impacts on biophysical and social environments / livelihood / health / gender</li> <li>No public concerns</li> <li>No legal issues</li> </ul>
<u>Negligible</u>	<ul style="list-style-type: none"> <li>Low/minor impact on environment / livelihood / health / gender</li> <li>Minor social impacts</li> <li>No legal issues</li> </ul>
Intermediate	<ul style="list-style-type: none"> <li>Some level of impact on environment / livelihood / health / gender</li> <li>Social issues apparent</li> <li>May have legal implications</li> </ul>
Severe	<ul style="list-style-type: none"> <li>High level impacts on environment / livelihood / health / gender</li> <li>High public concerns or perceptions</li> <li>Legal non-compliance</li> </ul>
Unknown	<ul style="list-style-type: none"> <li>Extent of the impact cannot be determined at this point</li> <li>Apply precautionary principle</li> </ul>

The chart below can assist to make a quick visual assessment of the significance of particular impacts, as well as the intervention as a whole.



CRITERIA Will the Project:	NO	YES	IF YES, ADDITIONAL SAFEGUARDS DOCUMENTATION AND MEASURES REQUIRED
or 5-15 m high with a reservoir exceeding 3 million cubic metres)	✓		and emergency response plan. <ul style="list-style-type: none"> <li>• RAP to be prepared and implemented.</li> <li>• Livelihood restoration plan to be prepared and implemented.</li> </ul>
Drainage (eg of wetlands), diversion or training of natural water bodies (eg. dykes, river training)		✓	<ul style="list-style-type: none"> <li>• ESIA/ESMP to analyse and address downstream and upstream impacts.</li> </ul>

**Recommendation:**

Scheme needs special attention

(has issues of ESC concern)

Scheme does not need special attention

(does not have issues of ESC concern)

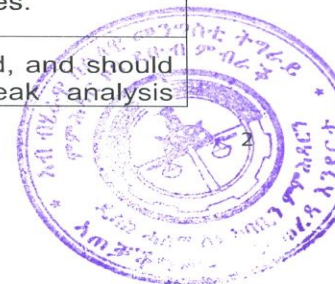
**Environmental, Social and Climate Issues Screening Checklist**

Scheme Name: \_\_\_\_\_

Region: \_\_\_\_\_ Zone: \_\_\_\_\_ Woreda \_\_\_\_\_

**Tier 2 Screening Checklist**

CRITERIA	NO	YES	IF YES, ADDITIONAL SAFEGUARDS DOCUMENTATION AND MEASURES REQUIRED
Will the Project:			
Require the acquisition of land, loss of assets, structures, trees, crops, and access to assets	✓		<ul style="list-style-type: none"> <li>RAP to be prepared and implemented.</li> <li>Livelihood restoration plan to be prepared and implemented.</li> </ul>
Affect physical cultural resources other than nationally or internationally recognised sites of importance – eg. religious sites, graveyards and graves	✓		<ul style="list-style-type: none"> <li>ESIA or ESMP to include chance find procedures, recommending actions to be taken in the event of a PCR find, including restoration and protection if necessary.</li> </ul>
Hinder or prevent access to livestock grazing areas or watering points	✓		<ul style="list-style-type: none"> <li>ESIA or ESMP to recommend specific locations to allow access to grazing areas and watering points.</li> </ul>
Require the use of agrochemicals (fertilizers, herbicides, pesticides, etc)		✓	<ul style="list-style-type: none"> <li>Pesticide Management Plan to be developed and implemented.</li> </ul>
Be located adjacent to, or within 2 km, of protected areas (eg. national parks, wildlife/nature reserves, biosphere reserves, priority forests, national or community forests), dispersal areas and buffer zones	✓		<ul style="list-style-type: none"> <li>Biodiversity Action Plan appropriate to the scale of expected impact to be prepared and implemented.</li> </ul>
Be located in an area that is highly eroded, or is susceptible to severe erosion	✓		<ul style="list-style-type: none"> <li>Integrated Soil Conservation and Nutrient Management Plan to be developed and implemented</li> </ul>
Involve construction/rehabilitation in hazard-prone areas, ie. areas most vulnerable to climate change and variability	✓		<ul style="list-style-type: none"> <li>Conduct climate risk analysis and propose appropriate resilience measures.</li> </ul>
Large-scale dam/reservoir construction (more than 15m high,	✓		<ul style="list-style-type: none"> <li>Full ESIA required, and should include dam break analysis</li> </ul>



CRITERIA Will the Project:	NO	YES	IF YES, ADDITIONAL SAFEGUARDS DOCUMENTATION AND MEASURES REQUIRED
or 5-15 m high with a reservoir exceeding 3 million cubic metres)	✓		and emergency response plan. <ul style="list-style-type: none"> <li>• RAP to be prepared and implemented.</li> <li>• Livelihood restoration plan to be prepared and implemented.</li> </ul>
Drainage (eg of wetlands), diversion or training of natural water bodies (eg. dykes, river training)		✓	<ul style="list-style-type: none"> <li>• ESIA/ESMP to analyse and address downstream and upstream impacts.</li> </ul>

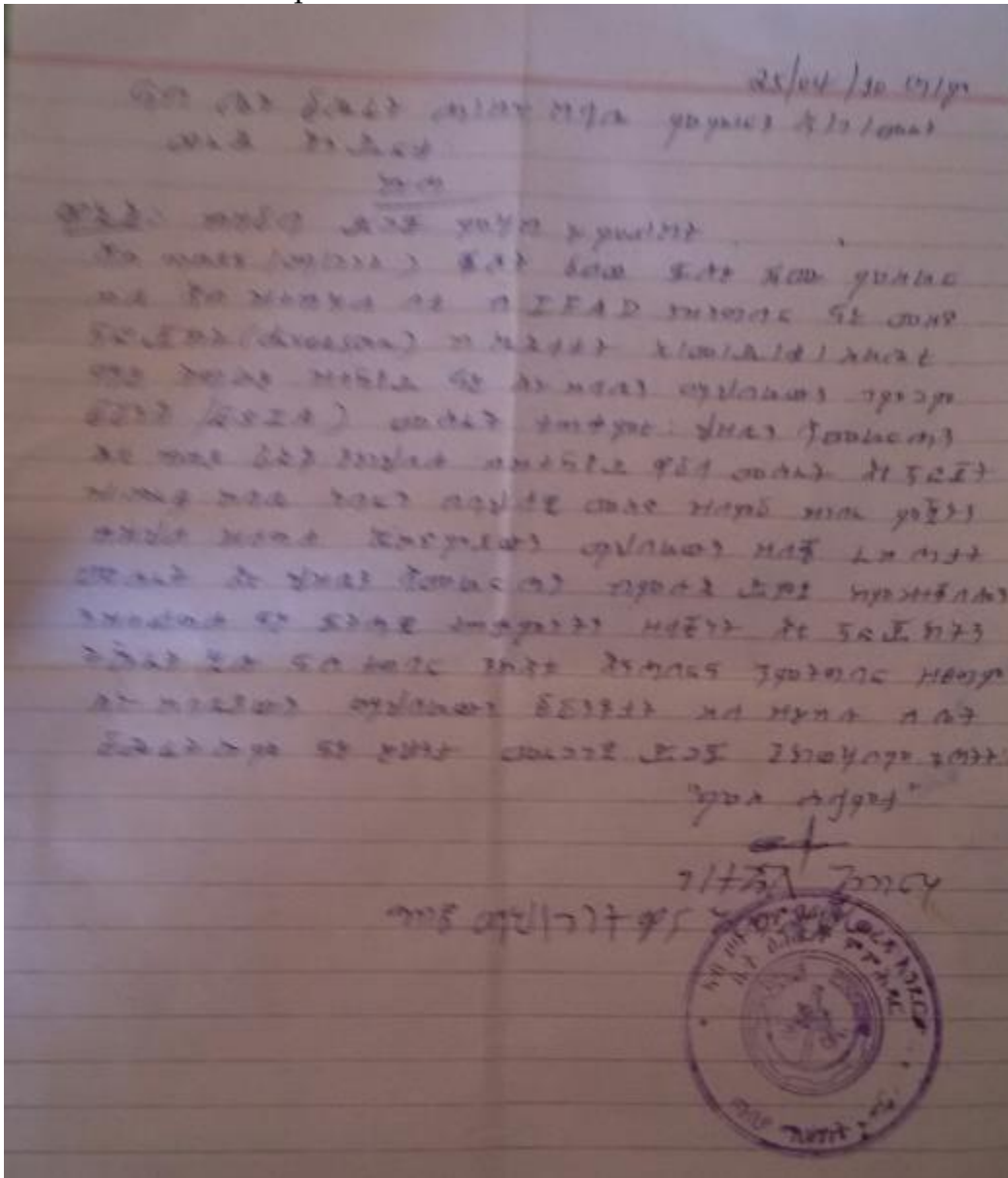
**Recommendation:**

Scheme needs special attention  
(has issues of ESC concern)

Scheme does not need special attention  
(does not have issues of ESC concern)



Annex 2. Public acceptance letter



Annex 3. Participants Of FGD

Public Consultation Participants  
Recording Sheet of participants  
Project: Misrar Teli  
Venue: Misrar Teli  
Date: 20/11/2011

S. No.	Name of participant	Sex	Age	Address (Village, Post, Taluk, District)	Amount PAID (approx. in Rs.)	Signature
1	...	...	...	...	...	...
2	...	...	...	...	...	...
3	...	...	...	...	...	...
4	...	...	...	...	...	...
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28	...	...	...	...	...	...
29	...	...	...	...	...	...
30	...	...	...	...	...	...

project - Indicators misrar-Teli (9<sup>th</sup> A.C. ml)  
discussio

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**Geo chemistry Laboratory Analytical Result Submission form**

SELECTED PHYSIO CHEMICAL AND BACTERIOLOGICAL ANALYSIS RESULTS					
Client/project : Tigray Region Water Works Study, Design and Supervision Enterprise					
SOURCE OF SAMPLE	Water	Water	Water	Water	WHO maximum allowable Concentration (mg/l)
Location					
DATE OF COLLECTION	09/04/2010 E.C	09/04/2010 E.C	09/04/2010 E.C	09/04/2010 E.C	
DATE RECEIVED	09/04/2010 E.C	09/04/2010 E.C	09/04/2010 E.C	09/04/2010 E.C	
CLIENTS ID.NO.	MST-S-1	MTS-S-2	MST-S-3	MST-S-4	
LAB.ID,NO	0233/2010	0234/2010	0235/2010	0236/2010	
Electrical Conductivity (µS/Cm)	1709	1733	1758	1762	
T. Dissolved Solid (mg/l)	1218.71	1235.82	1253.65	1265.5	
.R	0.4478	0.3757	0.3335	0.4073	
ESP	1.23	0.98	1.35	1.62	
P <sup>H</sup>	8.34	8.23	8.32	8.33	6.5-8.5
Sodium (mg/lNa)	21	19	18	22	358
Potassium (mg/l K)	2.65	3.01	2.98	3.05	12
Calcium (mg/l Ca)	143	165	182	174	200
Magnesium (mg/l Mg)	14	17	23	28	150
Chloride (mg/L Cl)	14.52	25.16	21.13	29.18	45
Sulphate (mg/l SO <sub>4</sub> )	243	251	278	285	400
Carbonate (mg/l CaCO <sub>3</sub> )	2.06	1.25	2.03	2.32	-
Bicarbonate (mg/l HCO <sub>3</sub> )	195.19	213.5	251.3	235.7	-
Nitrate (mg/l NO <sub>3</sub> )	10.72	15.13	17.14	18.62	45
REMARK: The test result can be compared with the WHO maximum allowable concentration (Mg/l) presented on the last column. The water sample was collected and submitted to our laboratory by client.					

Checked by: Abadi Romha

Signature \_\_\_\_\_

Date: 16/01/2018



Approved by: \_\_\_\_\_

Signature \_\_\_\_\_

Date \_\_\_\_\_

