

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

**RUBA CHEMIET PUMP IRRIGATION PROJECT
WOREDA WERIE LEKE
PARTIAL ESIA FINAL REPORT**

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EXECUTIVE SUMMARY

Ethiopia is one of the countries who have rapid population growth in Africa. At this moment the population of the country is over 90 million and this is the second populace country in Africa. When we see the economic growth of the country especially agriculture sector where more than 80% of the population is dependent on, even though there are promising things, it is still unable to change the life standard of the farmer. There are many farmers food insecure every year in the country as a result of unbalanced population growth and economic growth. Like any other developing countries, the most pressing problem in Ethiopia today is that of improving the economic and social condition of the vast number of people in rural area who live below the poverty line. In view of this concept the under listed pump irrigation projects have their own contribution in the economy by producing different types of crops in the farm. The agriculture of country mostly dependent on rainfall and similarly its productivity depends on the distribution of rainfall. When there is good rainfall distribution in both amount and time there is good yield if not the result will be the opposite. The proposed pump irrigation project is found in central zone of Tigray Woreda Werie Leke Tabia Adihedem in Chemiet River. In this report the project will have known by CHIEMIT Pump Irrigation Project and the pump station site is found with GPS located of 526153.71E and 1549464.41mN with elevation of 1748.71masl at Adihedem Tabia of Werie-Leke Woreda. The scheme is proposed to irrigate a net command area of 97ha in the Tabia. The Chemiet pump irrigation project command area have appropriate soil for perennial and annual crops and fruits. Currently the command area is cultivated land and has no significant vegetation cover, however scattered bush and shrub were observed during the field survey. The proposed pump irrigation project study was intended to describe biophysical and social environment situation of the project area. The overall objectives of the Chemiet pump irrigation development project is to ensure household food security, improve farmers income and alleviate poverty through increase in agricultural production and productivity resulting from irrigation water in the local area. The proposed Chemiet pump irrigation project

has been assessed in accordance with possible Ethiopia (National) & Regional Environmental Impact Assessment guidelines. The project site is selected by investigating different locations along Chemiet river course based on its geological stability, capacity to irrigate 97ha area, low adverse environmental impacts and low construction cost. The project has both positive and negative environmental and socio-economic impacts, but the positive impacts more crucial than the negative once making the proposed project acceptable. The project's positive impacts and anticipated benefits are increasing in agricultural yields and production due to improved drainage, increased and diversified food supply due to the provision of dry-season irrigation water, increasing in land values and price due to irrigation water, increasing in local development and employment, increased opportunities for high value crop productions and increasing and stabilizing the household income. Although the implementation of the project has many benefits; obviously it will have also some potential negative impacts on the bio-physical and socio-economic environment both during construction as well as operation phases unless mitigation measures are proposed. Thus, in this partial ESIA study, the issues that need special attention to realize the sustainability of the project, such as, impact on flora, gully soil erosion, creating barriers for movement, siltation, land slide, soil fertility and quality maintenance problems, sedimentation, health risks associated with vector borne diseases and water use conflict during scarcity of water are predicted and possible mitigation measures are proposed. Therefore, the study mainly focuses on identifying and proposing mitigation measures for potential negative impacts associated with the implementation of the project. This partial ESIA aims to develop baseline for future management and monitoring activities, identifying potential positive and negative impacts of the proposed pump irrigation project, propose mitigation measures for negative impact and identify ways of enhance positive impacts. This can be achieved through the measurement and analysis of the changes on the environment based on the baseline data. Monitoring will be done through observation, inspection, discussion with stakeholders, public consultation of the

beneficiaries and affected groups of the local community, interview etc. A continuous follow up of the changes and implementation of mitigation measures during construction as well as operation phases is the task of the proponent and its collaborative sectors such as Water resource development office, Environmental Protection office, Agricultural and Rural development office. Based on above objectives this report is partial Environmental and Social Impact Assessment (ESIA) of the Chemiet pump irrigation project prepared by Tigray Water Works Study Design and Supervision Enterprise (TWWSDSE) and the project proponent is International Fund for Agricultural Development (IFAD) Tigray Regional state branch office.

1. INTRODUCTION

Ethiopia is one of the countries who have rapid population growth. At this moment the population of the country is over 90 million. When we see the economic growth of the country especially agriculture sector where more than 80% of the population is dependent on, even though there are promising things, it is still unable to change the life standard of the farmer. There are many farmers food insecure every year in the country as a result of unbalanced population growth and economic growth. Like any other developing countries, the most pressing problem in Ethiopia today is that of improving the economic and social condition of the vast number of people in rural area who live below the poverty line. The agriculture of Ethiopia is mostly rainfall dependent and its productivity depends on the distribution of rainfall. When there is good rainfall distribution in both amount and time there is good yield if not the result will be the opposite. At this moment, to secure food for its people, the government is working hard. Many things are undergoing to change the agriculture of the country from rainfall dependent to irrigation. There are many irrigation projects under construction in different parts of the country. Even though it is not the only limiting factor of productivity in the country, securing water or moisture has big contribution in increasing production. Irrigation is not only a solution to areas which have shortage or erratic rain fall. In order to produce at least two times and secure food of the people, irrigation has to be introduced everywhere as far as there is water potential for irrigation. Werei-Leke Woreda is found in Central zone of Tigray region state. The Woreda has 33 Tabias and these Tabias are considered as a semi-dry area and agriculture in semi-dry areas depends upon the weather condition, especially rainfall. The project sites are characterized by low annual rainfall with poor distribution in amount and time. Periods of sever water stress are very common and this coincides with the most sensitive stages of crop growth. This generally leads to either low crop yield or total crop failure. Thus, rain fed agriculture is failing to meet the minimum food requirement and the commercial oriented crop production. Provision of water for irrigation is one of the major factors that greatly contribute to the socioeconomic

transformation and development of any area by improving the living standard, health and thereby increasing productivity of the community. Pump irrigation in Tigray regional state is not common but it is important to increase the productivity of the region for food security. Based on this the regional government is planning to develop Chemiet pump irrigation project in Tabia Adihedem Werie-Leke Woreda central zone of Tigray to irrigate 97ha net command area. During the study and design of the Chemiet pump irrigation project assessment of the baseline information of the environment is one part of the study, for its positive and negative impact exerted on the natural environment.

Chemiet pump irrigation project is proposed to be implemented in Woreda Werie-Leke, Tabia Adihedem along the Chemiet perennial river with GPS location of 526153.71E and 1549464.41mN with elevation of 1748.71masl. The main objective is to develop 97 Ha net irrigable area by construction of diversion scheme to produce farmers market oriented crop production and productivity. In line with this, IFAD has signed a contract agreement with Tigray Water Works, Study, Design and Supervision Enterprise to carry out the required feasibility study and detail design for the proposed small-scale diversion irrigation schemes. Thus, this is an environmental and social impact study whose ultimate aim is to ensure that environmental and social impacts of Chemiet pump irrigation are identified and properly managed.

1.1. Need for the Partial ESIA Study

The objective of EIA is to foresee the potential environmental problems that would arise out of a proposed development and address them in the project's planning and design stage. The partial ESIA process should then allow for the communication of this information to:

- The project proponent;
- The regulatory agencies; and,
- All stakeholders and interest groups.

The partial ESIA can enable the integration of environmental concerns and mitigation measures in the proposed pump irrigation project development. ESIA can often prevent future liabilities or expensive alterations in project design.

1.2. Scope of the Partial ESIA

The study includes detailed inventory of existing status of environment in the study area for various identified environmental components viz. air, noise, water, land, biological and socio-economic aspects. Under the scope of ESIA, it is envisaged to study:

- collate and review background data and information on the project and the existing environment;
- conduct field surveys of the study area
- Identify and recommend practical mitigation measures to reduce the potential impacts identified in the assessment. To assess the present status of air, noise, water, land, biological and socio-economic components of the environment in the study area.
- To identify, predict and evaluate significant impacts due to project activities on various environmental components during the Construction and Operational stages of the project.
- To delineate proposed pollution control measures and accordingly formulating Environmental Management Plan (EMP).
- To delineate post-project environmental monitoring programme to be implemented by proponent and its collaborative sectors.

2. Objective of the study

2.1. General Objective

The general objective of this study is to identify and predict possible environmental and social impacts of the pump irrigation project for minimizing or eliminating possible negative impacts by setting appropriate mitigation measures.

2.2. Specific Objectives

- Identify potential beneficial and adverse environmental and social impacts arising from the project
- Baseline information about the biophysical environment, social and economic conditions in the proposed pump irrigation project area.
- Information about the potential impacts of the project and the characteristics of the impacts magnitude, extent, duration and timing of the impacts
- Information on potential mitigation measures to minimize the adverse impacts with its mitigation cost
- To assess the best alternative project at most benefits and least cost in terms of financial, social and environmental concerns
- Information in public participation for project sustainability and sense of ownership
- To assess/evaluate the potential impacts of the pump irrigation project on the ecology, and socio-economic/health status of the people;
- To recommend preventive and remedial measures that may minimize adverse impacts and enhance the beneficial impacts of diversion construction.
- Develop environmental management plan with its monitoring plan for the diversion project.

3. Methodology and Approaches

A systematic approach was employed to investigate and assessment different aspects of the project in relation to the environment. Briefing the Woreda council/ Administration was implemented in the first phase as an entry meeting and continue to its respective sector offices, Tabia administration about the general objective of the pump irrigation project proposed in Chemiet River. Collection of secondary data was done by reviewing ESIA literature while collection of primary data as through field surveys, consultative meetings for consideration of opinions and concerns of affected and interested parties formed an important element of the process.

The Partial Environmental and Social Impact Assessment (ESIA) was carried out by reviewing ESIA reports of similar small scale irrigation projects, review relevant policies and strategies, collecting secondary data from different sources including Woreda and Tabia sector offices, collecting primary data through field observations, analyzed and environmentally interpreted; GPS used for locations of command area, catchment and pump station location, camera was used for essential picture collections, group discussions and consultations were undertaken with relevant offices and beneficiaries. The methodology adopted to achieve the objectives of the partial environmental and social impact assessment study:

- Secondary data collection from different governmental offices
- Stakeholder consultation
- Group focus discussion with beneficiaries and other stakeholders
- Interview local community members
- Discussion with project study team members
- Review EIA and other documents on similar projects

3.1. Review of EIA related documents

Existing documents on relevant Policies, Legislations, Guidelines and Previous studies were collected and thoroughly reviewed for assessing relevant environmental Policies, Laws, and regulations related to the expected environmental and social impacts of the proposed irrigation project development. In addition, available data and information

related to the project area and the proposed project development were assembled from Woreda sector offices, AD offices and Tabia Administration. All the data and information were analyzed for describing the baseline condition and identifying the major environmental and social issues in the project area.

3.2. Screening

All the parameters of the eligibility criteria are assessed and examined so that every components of the criteria are meet and permits to proceed to the screening step for farther study of the scheme. Screening was undertaken at early stages of project concept development the project study, by preparation and filling checklist as per the PASIDIP SECAP II guideline to decide whether the project needs full or Partial ESIA, ESMP. Accordingly, the project is found to be category B that requires partial environmental and social impact assessment to develop. The Woreda EPO has been participated in the baseline environmental assessment and supportive letter has been given to the study team according to the site assessment held. The screening checklist has been filled by the DA, Woreda EPO expert in collaboration with the study team and severity of the impacts are fail under the none, low and moderate categories.

3.3. Impact Scoping

A scoping process was conducted at a very early stage of the project to guide the environmental and social impact assessment activities. The scoping was based on review of pertinent legislations and previous studies, and reconnaissance field visit to the project area. The scope of the study was mainly based on the PASIDP quality assurance terms of reference.

3.4. Field Investigations and Data Collection

Detailed field assessment were conducted in the potential pump station, irrigation command area and its catchments, as well as in the corridor of the proposed main canal route and downstream area in order to have first hand intuition of the project environment, collect primary environmental and socio-economic data and identify the main environmental issues in the project site, and conduct consultations society and key stakeholders such as Agriculture and rural development office, health office, water

resource office, environmental protection office, education office etc. Contacting the concerned local offices (the above mentioned), relevant data and information on the natural and social environment of the project area were collected, and through discussions with the concerned stakeholders, their opinions and suggestions about the proposed project were obtained. In addition, consultations were held with the local community at the center of the Tabia administration to appraise the project and its implication, obtaining important information that help the impact analysis as complete as possible.

3.5. Stakeholder Consultation

As part of the transparent consultative process, and in order to take public views into inclusive account in determining the scope of the partial ESIA, a public consultative meeting was held in Adihedem Tabia Werie-Leke Woreda. This meeting was attended by relevant stakeholders and beneficiaries of the local community. The outcome of these stakeholder meetings and interviews provided relevant background information and helped identify major environmental concerns of the stakeholders within the project area.

A number of issues were raised during the stakeholder consultative meetings some of the points are summarized below;

- Generally most stakeholders welcomed the idea of constructing the pump irrigation in Chemiet river care should be taken for livestock water demands
- If there is no any loss of land holdings that will be affected by this pump irrigation project they assured to be more participants during the construction and operation phases of the project and they decided canals long the command areas will donate for free.
- The pump station should be designed located in safe zone not to affect by flood and hazards
- The government should be intensively committed in supervision during construction of the pump irrigation project and water management.

- The project should be introduced into action as much as possible within short period of time

3.6. Climate Vulnerability Assessment

Climate change poses a significant challenge to human security, socioeconomic development, and the environment. With global warming comes an increase in climate-related risks with more frequent and intense extreme weather events. With this increasingly uncertain future, it is vital for countries to be able to understand, manage, and plan for these climate risks. Ethiopia is already taking action, developing climate resilient green economy strategies and action plans to mitigate climate change impacts and its associated risks. However, there are still many challenges to be overcome when it comes to the development, coordination, and implementation of these strategies and plans.

Tigray regional state is vulnerable to climate change impacts, primarily due to the geographical distribution of its population and physical and/or economic assets (e.g., infrastructure, agricultural crops). Major climate and climate change hazards include droughts, and rising temperature loss of forest and grassland for agriculture, desertification, and land degradation are some of the main causes of climate change. Depending on the climate resilient green economy strategy in hand Woreda Werie-Leke administration is working to reduce climate risks by implementing intensive soil and water conservation such as trench, deep trench, percolation pond, bed trench structures and these structures are supported by biological conservations, area closure, rehabilitation of degraded areas with plantation, minimizing of deforestation, using alternative energy sources such as solar, electricity and improved stoves are among the activities implementing in the Woreda as whole and at the Tabia level to reduce climate vulnerability in the proposed pump irrigation project of Chemiet area.

4. Assumption/Gap in Knowledge

The community and the contractor may haven't enough knowledge about the environment during construction and operation activities respectively. So these gaps should be physical and biological components of the surrounding area of the project such as downstream water users, conservation, ecological balance, sedimentation, water born diseases, utilizations of safety materials during construction of the diversion, deforestation of endemic trees, efficient utilization of irrigation water and water management. These gap in knowledge will be addressed by consistent awareness creation activities by the woreda EPO, ARDO, HB, WRDO, contractor and other relevant stakeholders and finally the gap in knowledge will be narrowed by continuous follow up and regular monitoring of the above activities.

5. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS

5.1. Institutional framework

5.1.1. Federal EPA

In the year 1995, the EPA was formed by means of the Environmental Protection Authority Establishment Proclamation (Proclamation No. 9/1995). At the same time, an Environmental Protection Council (EPC) was established, with representatives from most of the federal ministries to supervise the EPA's activities. The Director-General of the EPA was to serve as the Secretary to the Council. The mandate and duties of the EPA were subsequently clarified in the Establishment of Environmental Protection Organs Proclamation (Proclamation No. 295/2002). Proclamation no 295/2002 was issued to re-establish the federal Environmental Protection Authority (EPA), to establish Sectoral Environmental Units and Regional Environmental Protection Agencies. In the recent time restructuring has further transformed EPA to Ministry of Environment, Forest and Climate Change (MOEFCC). Accordingly, the mandate and duties of the EPA were transferred to the MOEFCC including formulation of policies, strategies, legislations and standards about the environmental issues.

5.1.2. Regional EPA

Regional Environmental Protection Agency (REPA) have been established as provided by the Proclamation No. 295/2002, which decreed that each national regional state should 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. In Tigray regional state the sector has been established as Tigray regional state Environmental Protection Land Administration and Use Agency (EPLAUA). So based on this establishes the responsibility of regional governments in setting up its proclamations, regulations, guidelines and procedures. Tigray regional state environmental protection land administration and use agency (EPLAUA) has its own proclamations and regulations some of the very important proclamations are,

- Environmental impact assessment/EIA Proclamation number (2003 E.C),

- Pollution control proclamation number (2003 E.C)
- Solid waste management proclamation number (2002E.C).

5.1.3. Woreda EPA

Tigray regional state the has been established to the sector as Tigray regional state Environmental Protection Land Administration and Use Agency (EPLAUA) and at Woreda level was restructured as Environmental protection Land Administration and Use office (EPLAUO). The office is mainly responsible for carrying out activities related to environmental protection and land Administration and use at woreda levels of the region.

5.2. Policy frameworks

5.2.1. Environmental Policy of Ethiopia

In 1997, the Ethiopian government adopted the Environmental Protection Policy, which is based primarily on the conservation strategy. The main goal of EPE is and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the 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 EEP also provides overarching environmental guiding principles to be adopted to harmonize the environmental elements in sectoral, cross-sectoral and other policies. The policy clearly outlined the sectoral environmental policies, relevant to environmental management among others.

5.2.2. Water resources management policy and strategy

Ethiopian Water Resources Management Policy was set out in Proclamation No. 197/2000 (the "WRM Proclamation"). The policy is intended to promote comprehensive and integrated water resources management and optimal utilization of available water resources for sustainable socio-economic development. The policy calls for conservation and protection of water resources as an integral feature of the water resources planning and development process, and therefore mandatory EIAs of all water resource development projects. The Policy was elaborated in the Ethiopian Water Sector Strategy (2001), also known as the National Water Strategy whose purpose is to translate the

Policy into action. The Strategy is a comprehensive document, covering all aspects of water resources development and management. Inter alia, it calls for mandatory EIAs for all water projects, and promotes gender mainstreaming. From an environmental point of view, it is interesting that the Strategy includes a call to "Reclaim existing wetlands" by drainage and other means, but not for their conservation or the protection of wetland values.

5.2.3. Agriculture and rural development policy and strategy

The GOE's development policy framework was heavily based on the concept of Agricultural Development-Led Industrialization (ADLI). The Rural Development Policy and Strategies (RDPS, 2003) presents specific policies and strategies to guide agricultural and rural development, based on the ADLI platform. The RDPS recognizes that the development effort in rural areas cannot be limited to agriculture alone. There is a need for rural infrastructure and social development programs and for trade and industry to build on and support developments in agriculture. Key elements of the RDPS include: rural and agricultural centered development as a means of:

- (i) ensuring rapid economic growth;
- (ii) enhancing benefits to the people;
- (iii) eliminating food aid dependency;
- (iv) promoting the development of a market-oriented economy.

5.2.4. Food security strategy

This strategy addresses both the supply and the demand side of the food equation - that is, availability and entitlement respectively from both a national and household level perspective. Within this, particular attention is focused on the diversity of food production zones in Ethiopia (i.e. areas with adequate moisture, moisture deficit and pastoral) to tailor options and strategies accordingly. The three basic pillars on which the strategy rests are:

- To increase the availability of food through increased domestic production,
- To ensure access to food for food deficit households; and
- To strengthen emergency response capabilities.

5.2.5. Health policy

The GoE issued its Health Policy in 1993, which was issued based on the result of a critical examination of the nature, magnitude and root causes of the prevailing health problems of the country and awareness of newly emerging health problems. The Policy accords appropriate emphasis to the needs of the less-privileged rural population which constitute the overwhelming majority of the population and the major productive force of the nation. In order to achieve its goal, a twenty year health sector development strategy was formulated in 1997, to be implemented through a series of five-year plans. The last phase (HSDP-IV) was implemented from 2010/11 - 2014/15. The Federal Ministry of Health has recently launched a new strategy: the "Ethiopian National Health Care Quality Strategy (2016 - 2020): Transforming the Quality of Health Care in Ethiopia". This latest Ethiopian National Healthcare Quality Strategy (ENHQS) builds on the plan laid out in HSTP to further drive large-scale improvement in quality of care delivery over its planning period.

5.2.6. Conservation Strategy of Ethiopia

The Conservation Strategy of Ethiopia (CSE) sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of sectoral as well as cross-sectoral interventions for the management of Ethiopia's natural, man-made and cultural resources. The CSE provides a strategic framework detailing principles, guidelines and strategies for the effective management of the environment.

The most important areas that are considered in the document include the following:

- Improvement of soils, crop and animal husbandry for sustainable agricultural production.
- Management of forest and woodland resources.
- Development of water resources for irrigation, hydroelectricity and water supply.
- Rangeland management and pastoral development.
- Promotion of individual participation in sustainable development of natural, artificial and cultural resources, and environmental protection.

- Land resource use policy and strategies; physical land use planning.
- Integration of social, cultural and gender issues in sustainable resources and environmental management.
- Development of environmental education, public awareness and human resources.

5.2.7. National Biodiversity Policy

The biodiversity policy was approved in 1998 and it provides policy guidance towards the effective conservation, rational development and sustainable utilization of the country's biodiversity. The policy objectives accentuate public participation in biodiversity conservation, development and utilization, and also ensure that communities share from the benefit accrued from the utilization of the genetic resources and their traditional knowledge. The policy consists of comprehensive provisions on the conservation and sustainable utilization of biodiversity, and it underlines the requirements for implementers to adopt during planning and operational phase of projects and for those projects engaged in biological resource utilization to follow ESIA procedures.

5.2.8. Climate Resilient Green Economy

The Climate Resilient Green Economy (CRGE, 2011) is Ethiopia's overarching framework and a national strategy towards a green economy. The Green Economy Strategy is believed to provide an opportunity to promote sustainable development in Ethiopia. Currently it builds on an investment plan of over 60 initiatives that are, or can be, turned into financed projects. For this to happen there is a strong need to reform the economy. The CRGE is envisioned to be the main driver for this transformation. The CRGE has three complementary objectives: i) fostering economic development and growth, ii) ensuring abatement and avoidance of future GHG emissions; and iii) improving resilience to climate change. To achieve these objectives CRGE sets out to tap into international climate finance, seize opportunities for innovation and new technologies, and create competitive advantages via sustainable resource use and improving productivity. Thematically the investment plan covers four different areas of

work: 1) Improving crop and livestock production practices for reduced emissions, and increasing food security and farmer income; 2) Protecting and re-establishing forests for their carbon stocks and other ecosystem services; 3) Expanding electricity generation from renewable sources of energy for domestic and regional markets; and 4) Moving quickly to modern and energy-efficient technologies in rural cooking, transport, industry, and buildings. While building a climate resilient green economy, Ethiopia's vision is to achieve middle- income status by 2025.

5.2.9. Wetlands

Wetlands are considered among the most productive type of ecosystem in the world, providing benefits far in excess of those obtained from alternative uses to which they are subjected. Ethiopia is endowed with vast wetlands, including a tract in the project area; however, efforts towards their conservation and sustainable utilization are very limited, and no clear policy and legislative framework have been designed.

5.2.10. National Cultural Policy

The Cultural Policy was put into effect after being endorsed by the council of Ministers of the FDRE in October 1997. This Policy was issued recognizing the fact it is high time the heritage, history, fine arts, handicraft and folk art (tales, proverbs, popular poetry, dance, songs, etc) of the nations, nationalities and people of Ethiopia are collected, registered, analyzed and preserved from any form of adulteration, and that these are given equal recognition and right to develop. It is also aimed at promoting national, continental and international cultural Cooperation on the basis of the equality of people's culture and their mutual benefits. Accordingly, the Policy provides the general principles and guidance for subsequent actions to realise its desired objectives including strategic, legal and procedural frameworks and directions to follow. The major elements of the policy, therefore, describe needs to be considered with regard to: Inventory and Standardization; Study, Research and Development; the Establishment and Expansion of Cultural Institutions; the conservation, preservation and inspection of heritage; the Repatriation and Restitution of Heritages; Developing Languages and Providing Professional Assistance While Determining the Language for use: Initiating and

Encouraging Creative Artists & Other Professionals; Protecting the Right of Property to Creative Works and other Related Rights; the Spread of Cultural Knowledge; and several other administrative aspects.

5.3. Legal frameworks

5.3.1. Constitution of FDRE

Ethiopia adopted its Constitution in 1995, which provides the basic and comprehensive principles and guidelines for environmental protection and management in the country. The concept of Sustainable Development and environmental rights are enshrined in Articles 43, 44 and 92 of the Constitution of FDRE.

Article 43: the right to development, where people's right to:

- Improve living standards and to sustainable development.
- Participate in national development and, in particular, to be consulted with respect to policies and projects affecting their community.
- The enhancement of their capacities for development and to meet their basic needs, are recognized.

Article 44: Environmental Rights,

- All persons have the right to live in a clean and healthy environment
- All persons who have been displaced or whose livelihoods have been adversely affected as a result of state program have the right to commensurate monetary or alternative means of compensation, including relocation with adequate state assistance

5.3.2. Proclamations EIA proclamation no 299/2002

This proclamation elaborates the assessment of positive and negative impacts on the basis of size, location, nature, cumulative effects, etc. It makes EIA mandatory for projects based on the directive no 1/2008, issued to determine category of the proposed activities. The directive categorizes projects in to three schedules as 1, 2 and 3. Schedule 1 projects require full EIA, schedule 2 will require partial EIA and schedule 3 require no

EIA. Thus, the proclamation is relevant to this project as it was categorized schedule 1 during the screening process.

5.3.3. Pollution control proclamation no 300/2002

The proclamation addresses environmental pollution due to related management of hazardous wastes and establishment of environmental quality standards for air, water and soil. The construction of this project may generate solid wastes such as spoil, gaseous emissions, machinery leakages and ambient noise. Moreover, the operation irrigation projects may use agrochemicals such as inorganic fertilizers and pesticides which may pollute the natural environment.

5.3.4. Rural land administration and use proclamation no 456/2005

This proclamation is aimed to ensure that compensation shall be paid to the land use holder or substitute land shall be offered for registered land to be acquired for public purposes. Moreover, the proclamation imposes restriction on the use of various categories of land, for example wetlands, steep slopes, land dissected by gullies, etc.

5.3.5. Forestry conservation, development and utilization proclamation no 94/1994

This proclamation is aimed to ensure that the conservation of existing forests and establishment of state forest to conserve forest resources within their ecosystem. The proclamation prohibits the felling *Hagenia abyssinica*, *Cordia africana*, *Podocarpus gracilior*, *Juniperus procera*, and *Olea europaea ssp. Cuspidata*) from their natural habitats.

5.3.6. Labor proclamation no 377/2003

The proclamation established 48 hours working & one day rest/week, overtime rates, paid leave, the 12 national public holidays, and maternity leave. It sets minimum age for young workers at 14 years. The proclamation is relevant to this project because it may hire labor during construction, and when the scheme is in operation, farmers employ farm hands to help them at times of peak farming seasons (e.g., cultivation, weeding, pesticide applying, harvesting etc.).

5.3.7. Water resources management proclamation no 197/2000

This proclamation is to ensure that management of water resources is carried out properly & harmful effects of water resources are prevented. The proclamation prohibits clearing and cutting trees or vegetation and construction of residential houses within the delimited banks of water bodies. The proclamation is relevant to this project as the schemes entirely depend on availability of water resources, which needs conservation, efficient use and protection.

5.3.8. Pesticide registration and control proclamation no 674/2010

This proclamation requires all pesticides to be registered to ensure safety on humans, no-target organisms and the environment. It prohibits importation of highly hazardous and banned pesticides; and, requires that all pesticides to display labels per MOA label requirements. Due to the operation of this project, some crops under irrigation would be susceptible to pests and require management.

5.3.9. Expropriation of landholdings for public uses proclamation no 455/2005

The proclamation establishes the legal principles and frameworks for expropriation of landholding. Based on this proclamation regulation no 135/2007 was formulated as a procedure to pay compensation for the affected properties. As all the project structures will be constructed on communal land, it does not expropriate individual land and therefore this proclamation does not apply to this project.

5.3.10. Physical and cultural properties Proclamation no 839/2014

Proclamation no 839/2014 provides for the procedures and management of national and regional cultural heritages. At regional, zonal and woreda levels, heritage issues are managed and administered by respective bureaus and offices of culture and tourism. During the field survey study and information from woreda culture and tourism office, no any physical and cultural properties were identified and therefore the proclamation do not apply to this project.

5.3.11. EPA guidelines Environmental impact assessment guideline (EPA, 2000)

An environmental impact assessment guideline provides the policy and legislative framework, the general ESIA process and key sectorial environmental issues and

standards. This guideline has been considered as relevant to the project as it causes potential adverse environmental and social impacts.

5.3.12. Procedure for the preparation of environmental management plans (EPA, 2003)

This document provides the essential components to be covered in any environmental management plan (e.g., Identified impacts, mitigation measures, monitoring, capacity building, etc). It contains structured formats for mitigation measures, monitoring and institutional arrangements.

5.3.13. Environmental impact assessment guideline for irrigation projects (EPA, 2004)

This guideline covers all types of irrigation projects including water harvesting, storage, conveyance, on-farm distribution and drainage etc. The document highlights major issues and potential impacts with appropriate enhancement and mitigation measures to be taken during preparation and assessment phases.

5.4. IFAD safeguard policy

5.4.1. 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.

5.4.2. 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.

5.4.3. 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 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.

5.4.4. 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.

5.4.5. 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'.

5.4.6. 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,

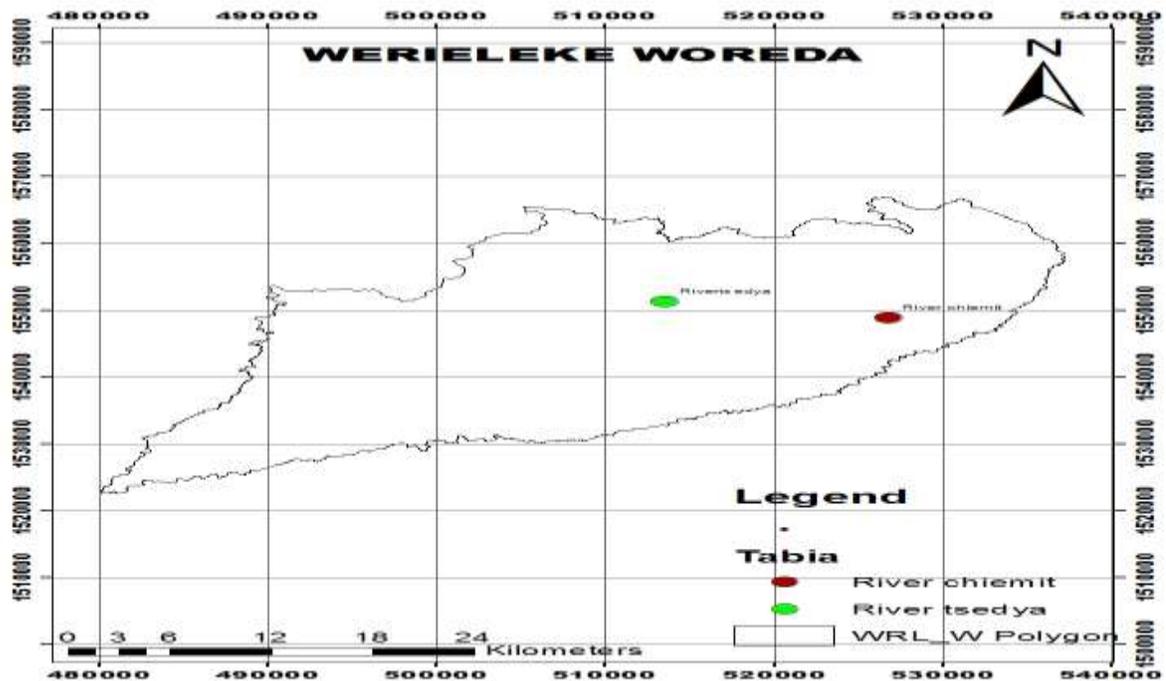
particularly to climate change, is done in an environmentally and socially responsible manner. The procedures set the minimum standards for the assessment of social, environmental and climate change risks of IFAD projects which apply throughout the project cycle.

6. DESCRIPTION OF THE PROJECT

6.1. Project Location

Woreda Werie-Leke administration is found in central zone of Tigray regional state. The neighboring boundaries of the Woreda are at the East Hawzen Woreda on the West- Adwa Woreda South- Kola Tembein Woreda and North-Ahferom Woreda. The capital of Werie-Leke Woreda is Edaga-Arbi town, which is 69 Kilometer far from the Zonal Capital Axum and 170 Kilometer far from the regional Capital Mekelle on the main high way Asphalt Road Abiyi-Adi-Adwa. The Woreda comprises 33 Tabia administrations. Chiemit pump small scale irrigation project area is found in Adihedem Tabia administration in which the pump station site is located at Ruba Chiemit River 33 kilometer far from Edaga-Arbi town the Woreda capital. Chiemit pump irrigation project site is situated at 526153.71E and 1549464.41N at elevation of 1748.71masl. The command area of these irrigation schemes is situated along the main gravel road running from Edaga-Arbi to Nebelet to the right side of road.

Figure 1. Woreda Werie-Leke map



6.2. Project Components

The proposed small scale irrigation which is pump irrigation project mainly involves pump station of irrigation water from Chemiet River to irrigate the proposed command area of 97ha agricultural land in Adihedom Tabia. This is a pump irrigation system where the pump station pumping water from the river to the proposed reservoir tanks and then distribute the water by gravity to the command area through the main canal and then the main canal supply the secondary and tertiary canals.

6.3. Pump Station

The pump station is located at the river Chemiet at 526737E and 1548921N at an elevation 1718.953 above sea level. Irrigation water from the pump station site would pumping the water from the river through pipelines for about 2.5 km to the reservoir pond. The length of raising pipeline is 1332m, gravity pipeline 1060 meter and deliver the irrigation water directly to the secondary canals 668.37m and then to tertiary canals which is 3377.74 meter. The tertiary canals then feed field canals to irrigate a net command area of 97 Ha with gravity irrigation.

Figure 2. Location of pump station



6.4. Pond Station

The pond station of Chemiet pump irrigation project is situated in two places as pond station 1 and pond station 2 to the western side of the command area with GPS location of pond station 1 at 525599.82E and 1549420.99N at an elevation of 1773.00m above sea level and the capacity water holding of the pond stations is 332m³. The pond station 2 is located at 525214E and 1551268N at an elevation of 1778.4m above sea level and proposed if additional pond is required depending on the irrigation schedule.

Figure 3. Location of pond station



6.5. Water Resources

There are many rivers flowing throughout the year in the Woreda. The main ones are Werie, Chemiet and Tsediya rivers. According to the hydrology report, the average flow/base flow of the Chemiet river is calculated to be 193.25 L/sec and quantity of water to the irrigation scheme is calculated to 152.07L/sec to irrigate 97 ha command area and downstream water users flow is measured to be 48.3 L/sec which is the 25% of the base flow of the river will be released to downstream. According to the data collected from the Kebele the total livestock population water demand around the

project is calculated to be 256,893L/day. Measurement was taken at the end of December 2017 based on this the hydrological flow can reduce during the dry season. According to the data obtained from the Woreda Water Resource Development, Mines and Energy office the river has not used for drinking purpose instead it is used for other services like animal consumption, washing cloth and the like. So the designers are considered the minimum base flow to maintain the ecological balance of the river and for the downstream water users like construction of cattle traff.

6.6. Infrastructure

To facilitate rural development in the region, infrastructure is essential for many reasons such as to deliver agricultural inputs like fertilizers, pesticides, herbicides and other chemicals using for agricultural productivities. On the other hand why road infrastructures mandatory is that it can help to transport the harvested agricultural products to the market centers located within the command area, for storage in safe places etc. In the case of Chemiet pump irrigation project site is accessible for all weathered road with regular maintenance of the community road which takes to the command area so that, in this project construction of new access road is not a major issue. But during the construction time temporary road will be constructed to deploy construction materials to the pump station of the pump irrigation scheme. Since the proposed pump irrigation of Chemiet scheme will be constructed during dry season, the temporary access road will not compensate and the landholder or the farmers are well informed and freely donated their lands for temporary time especially during the construction phase of the project.

In this proposed pump irrigation scheme there is small town in the Tabia center and it has market center every Saturday Sheds, offices and sanitation facilities within the project area will be located out of the farming land in the small town which has access road and electric power supply. So that, there will not have loss of cultivated land for this purposes and no more of compensation is needed since it is communal land of the Tabia.

6.7. Source of Construction Materials

Small scale irrigation projects uses local materials provided by the local community of the Tabia. The proposed Chemiet pump irrigation project will use the construction materials such as stone, hardcore, gravel, sand, water from the nearby project site proposed by geologist during the study time with a careful management on the environment and other materials such as cement, pipes, metals will be provided by the contractor for quality construction of the pump station, ponds and other components of the pump irrigation.

Labour requirements of the project will be obtained from the local administration of Adihedem Tabia as indicated in the positive impacts of the project it is advantageous in creation of job to the local community. The number of labours estimated to involve in this project can reach up to 200 people including both skilled and unskilled labours within this in mind these construction workers can generate solid and liquid wastes so that the contractor should have to prepare sanitation facilities and proper waste management system within the construction camp to prevent communicable diseases and other pollutions to the surrounding environment.

Construction methodology of the proposed pump irrigation will be manually by local labour forces and the construction should be implemented during the dry season in order to not to damage crops of the cultivated land. During the construction period contractor should provide all necessary occupational health and safety materials for all construction workers to avoid any health hazards and injuries in relation to this project. Field investigations for locating and evaluating economic source of construction materials at near the pump irrigation have been conducted. Sources for construction materials including rock quarries, coarse aggregate, fine aggregate, water and borrow sources for improving materials and fill is studied.

Thickness and material type information was gain from the gully sections and open existing borrow pit and cut sections. All the location coordinates of the borrow sites are taken from middle of the delineated areas (polygon). Width is the distance perpendicular to the major trend of the material or weathered rock. Length considered

as the distance parallel to the major orientation of the geologic units. All material source locations have presented in table below.

Table 1. List of potential borrow areas with specific locations and estimated volumes

Borrow Name	Easting (m)	Northing (m)	Volume. m ³	Land use	Remark
B1	525379.5	1547641.65	30000	bare land, piled material	highly weathered and gravelly slate rock
B2	525414.5	1547810.65	12000	bushes and grasses on small mountain	highly weathered and jointed slate rock
B3	526604.5	1549992.65	20000	rocky fragmental and bushes	highly weathered and gravelly slate rock
B4	525662.5	1550745.65	5000	ridge with few bushes	moderately to highly weathered and gravelly slate rock

Table 2. List of quarry sites with their specific locations and estimated volumes

Quarry Name	Easting (m)	Northing (m)	Volume. m ³	Land use	Remark
S1	526010.462	1549420.65	1940	few bushes	fresh, bedded and crystalline limestone
S2	536368.482	1547890.65	1560	fragmental and massive rocky land	fresh, massive and crystalline limestone
S3	526266.463	1547687.65	2350	fragmental and massive rocky land	fresh, massive and crystalline limestone
S4	525230.461	1551328.65	1320	bare land	fresh, bedded and crystalline limestone
S5	525329.461	1551432.65	7560	grasses and bushes	fresh, bedded and crystalline limestone

6.8. The Water Quality of Chemiet River

In general the water quality of the river is determined by using AC-meter in the location of the pump station of the water body. According to the water quality parameters of water using for irrigation it is compulsory to investigate the physical and chemical

water quality parameters of the river Chemiet. The most important parameters that should be considered for irrigation water quality parameters classification includes salinity, electrical conductivity (EC), turbidity and total dissolved solids (TDS) values, To identify the irrigation water source Chemiet river, water quality, samples were collected from pump station site and analyzed for some basic parameters by using AC meter to identify the baseline quality status of the river water. Accordingly the water quality result of Chemiet River is given in the table below.

Table 3. Water quality analysis of the river Chemiet

No	Components	Water quality measured	Potential Problem
1	Resistivity	1.14K Ω	Low
2	TDS	437.7ppm	None
3	E.C	875.5 μ S/cm	Low
4	Salinity	0.27 ppt	97% suitable for irrigation purposes

From the water samples analysis results, the average EC_w was found to be, 875.5 μ S/cm indicating that from Chemiet River water it is possible to achieve 97% irrigation agricultural yield without any problem for all crops recommended by agronomist. For the salinity value in ppt of hazard is classified as; below 0.25 Excellent, 0.25 to 0.75 good, 0.76 to 2.00-Permissible, 2.01 to 3.00 Doubtful and over 3.00 Unsuitable (FAO,1989) hence the Chemiet river salinity test result 0.27 ppt and it falls under the excellent range.

6.9. Application of Agrochemicals

The most common practice that are using for soil nutrient management is application of inorganic fertilizer. Nevertheless, increasing price of the chemical fertilizers is becoming a challenge to many of the farmers. The rainfall variability is also another risk for the farmers to apply chemical fertilizers. Chemical fertilizers are also part of the integrated soil fertility management practice in the area. Use of soil test based fertilizer application is advised as the best method, in fertilizer application. The recommended rate of fertilizer for project area is NPKSB, NPKSZnB and NPKSFeZnB.

6.10. Pest management

Insect pests are one of the major production limiting factors in the study area. These agents are also expected to be more problematic in the forthcoming irrigation agriculture. Especially if there is no crop rotation, insect pests will build up through time and will cause significant yield loss. Hence, integrated pest management method (**IPM**) is proposed to manage insect pests in the study area. The main pest control practices to be integrated in the system include frequent plowing, timely sowing, timely harvesting, optimum plant population, intercropping, crop rotation, crop sanitation, trap cropping, observing off-seasons, resistant varieties, removing alternate hosts and chemicals. Nevertheless, priority should be given to non-chemical methods and chemicals should be used if there are no other control possibilities.

6.11. Crops Production and yield

The crops growing in the study area are annual crops and they are grown under rainfed condition. The major crops growing in the study area are teff, maize and sorghum. Other minor crops are also growing in the study area. These crops include wheat, barley, lentil and chickpea. However, these crops cover very limited area. This cropping pattern is mainly based on the feeding habits of the farmers. In the study area, crops are also growing under irrigation. These crops include vegetables (tomato, pepper and onion) and perennial crops (mango, papaya, citrus, banana, and guava). The data obtained from the study area Adihedem Tabia indicate that in the year 2010 E.C about 36.24 ha in have developed under irrigation. This area is developing once a year. The irrigation season is December to April. The source of irrigation water could be pumping from rivers micro dam

Table 4. Crop production and yield of the study area

crops	2008 EC		2009 EC		2010 EC	
	Area (Ha)	Yield Qt/ha	Area (Ha)	Yield Qt/ha	Area (Ha)	Yield Qt/ha
Teff	112	6	125	6	125	5
wheat	10	5	8	18	8	18
maize	267	22	287	35	287	28
Barley	8	7	6	7	6	7
Sorghum	349	18	379	40	379	20
lentil	4	3	4	3	3	3
Chickpea	2	4	4	3	1.5	3.5
pepper	2.5	4	2	3	2	2
Bannana					1.6	69.437
papaya		-			4.14	69.4
citrus	8.34	34.6			12	34
Mango	7.69	39			16	9.75
coffee					0.5	69.437

Source: agriculture and rural development office of the respective tabia

7. DESCRIPTION OF BASELINE OF THE ENVIRONMENT

7.1. Physical Environment

7.1.1. Location

The pump irrigation project is found in Tigray region, Werie-Leke Woreda in Tabia Adihedem, with GPS location of 526153.71E to 1549464.41N at an elevation of 1748.71 about 33 km far from the Woreda center Edaga-Arbi town. This proposed pump irrigation project is expected to irrigate a net command area of 97ha.

7.1.2. Topography

As observed from topographic maps, image of the area and field observation made by the study team, the study area can be divided in to two topographic features. Mountainous and rugged found at the upper and peripheries part of the catchment that is commonly used as forest land and free grazing land and the gentle slope topographies that are commonly found at the lower and along the main river of the watershed are commonly used as cultivated land. Chemiet pump irrigation project site falls under semi-arid dry "Weynadega" with elevations range of 1748.71m a.s.l.

7.1.3. Climate

Climate is the most important dominating factor influencing the suitability of a crop to a particular area. The yield potential of the crop mainly depends on climate. The most important climatic factors that influence growth, development and yield of crops are rainfall temperature and solar radiation. The meteorological station for the project area is Edaga-Arbi Meteorological station.

7.1.4. Rainfall

The rainfall pattern in most parts of the District is bimodal, with the bulk of rains falling in the months of June and August. The months of September – February receive small quantities of rain District office of agriculture and rural development (DOARD) 2017. Whereas, in this reconnaissance survey, based on discussions made with community members and data obtained for the study area, the longer rainy season with better amount of rainfall usually occur in the months of mid-June to mid-September, while the shorter with smaller amount of rainfall occur in March and April. The data (2005-2017) from NMA indicated that, the mean annual rainfall of the area is 776.25 mm. The

distribution of the rain fall in the area is not uniform. The rainfall pattern is mono-modal with more than 85 percent of the annual rainfall extends from June to September. Figure 1 shows the highest rainfall was observed in the month August (296.0 mm) followed by July (204.1 mm) however; the rainfall in other months is negligible. It indicated that there has been a tremendous variation / fluctuation in the rainfall pattern in the study area.

7.1.5. Temperature

The mean minimum and maximum annual temperatures of the area are 8.9 and 24.2o C respectively. The hottest season is from December to March with average temperature ranges from 25-30'c. The coldest season is from December to January with the temperature ranges of 7.0 o C to 7.1 o C.

7.1.6. Geology

The regional geological map of the project area comprises Precambrian metamorphic rocks, Upper Palaeozoic to Mesozoic, Cenozoic volcanic rocks and recent deposits. Based on the Geological Map of Ethiopia (GSE) and Geological Map of Adigrat area (Adigrat Sheet) the project area comprises; Tsedyia slate, Werie slate, Assem limestone, Edaga Arbi Glacials, Enticho sandstone and Tsaliyet group. The dominant rock unit in the immediate project boundary is Precambrian Upper Complex unit (metamorphosed sedimentary rocks).

7.1.7. Land use

Land use within the command areas and their catchments reflects the land cover. Almost all the land within the command areas is used for cultivation of food crops except the areas used for settlements, infrastructures, religious sites and some tree plantations. The main land use and land cover of the Woreda in which the proposed irrigation project comprises cultivated land, grazing land, forest land residence area covers and miscellaneous land are estimated. As of the data obtained in the Woreda Agriculture and Rural development office the majority of the perennial crops type cultivated in the Woreda include Teff, wheat, Maize, Barley, Millet etc used as an

annual crops. According the information obtained from finance and plan office of the Woreda, the land used of the Woreda are presented as following

Table 5. Land use of the woreda and the study area of the project

Sr. No	Land Use Pattern	Areas/woreda	Adihedem	Adi_Regeto
1	Cultivated land	22,149	5843.5	625
2	Forest land	16,805	25	-
3	Marginal land	72,21.84	7.3	550
4	Grazing land	10,626.6	-	217
5	Home steady	4,037.4	48.5	97.25
	Irrigable land	6,341.5	355	25.64
6	Miscellaneous land	29,502.14	145.5	132
	total	125,830.05	2,750	1649.89

Woreda and Respective Tabia Administration, 2017G.C.

7.1.8. Soil

The dominant soils types are cambisols, Regosols, and Leptosols. These soils are not uniformly distributed in the command area. The sandy loam soils are dominant almost in all part of the command area. Based on the assessment made, the dominant soil types were found to be, 1- mineral soils conditioned by topography, 2- mineral soils conditioned by limited age. Mineral soils conditioned by topography include Regosols with eurtic qualifiers (alluvial soils) Leptosol with Lithic qualifier. The mineral soils conditioned by limited age are Cambisols with eurtic qualifiers. The area distribution of the major soil types are Cambisols 50.5 %, Leptosols 23 %, Regosols 26.5 % .The proportion of area occupied by the corresponding major soil types is shown in Table below.

Table 6. Soil type and coverage of the study area

Soil type	Area coverage (ha)	Percentage (%)
Cambisol	51.5	50.5
Regosol	23.5	23
Leptosol	27	26.5
Total	97	97

7.1.9. Hydrology

Chemiet River is one of the perennial river of the Woreda which flows to the south direction of the Woreda. The base flow of the river is 193.25 L/sec and quantity of water to the irrigation scheme is calculated to 152.07L/sec to irrigate 97 ha command area and downstream water users flow is measured to be 48.3 L/sec which is the 25% of the base flow of the river will be released to downstream. Measurement was taken at the end of December 2017 based on this the hydrological flow can reduce during the dry season.

7.2. Biological Environment

7.2.1. Vegetation

The proposed pump irrigation projects of the Chemiet pump irrigation scheme is dominated by Acacia trees and scattered drought resisting trees. The area also has dominated by indigenous trees most of acacia species specially the Acacia Abyssinica. The project will not affect any natural forest or any protected zones.

The flora coverage of the command area and its nearby catchment has extensively been altered by human activities including cultivation, livestock grazing, settlements and exploitation of trees shrubs for construction and fuel wood purposes. Almost the lands in the command area and around the catchments are covered by annual crops. The uncultivated lands are partially grazed by livestock. The predominant tree species found in most of the protected areas is Acacia ethbaica (Seraw). Other major indigenous tree species include Acacia sieberiana (Nefacia), A. seyal (Keyih & Tseada Chea), A. albida (Momona), A. toritils (Aqba), Combretum molle (Weiba) and Zizyphus spinachristi (Geba).

7.2.2. Wildlife

In the Woreda there are different types of wild animals and birds. As indicated by local informants, records obtained from Woreda Werie-Leke Agricultural and Rural Development office, Environmental Protection office the main wild animals found in the area includes Hyena, Monkeys, Fox, Rabbit are predominant and in addition to these wild animals different species of birds are common also. The most common mammals found in the project area include Anubis Baboon (Hebey), Velvet Monkey (Waeg), Striped Hyena (Zebie), Abyssinian Hare (Mantile), Common Jackal (Buqariya),

the names in brackets/*italic* are in Tigrigna language. In addition, the pump irrigation project areas have been observed a variety of bird species amongst which the most common ones include Francolin (Kokah), Helmeted Guinea Fowl (Zagira), Duck (Duro Eriba), Crow (Kuah), Dove (Erbit), Pigeons (Dabo) etc.

7.2.3. Sensitive Environment

In the proposed Chemiet pump irrigation site there is no any international treated as sensitive habitats' such as national parks, reserves and wetlands.

7.3. Socio-Economic Environment

Most the residents of the command areas are led their livelihood on mixed agriculture and it is understood the predominant livelihood of the project area people is mix agricultural, they are engaging in income-generating activities such as raising livestock, and it is also participating in off farm and petty trade and salary based income, these are the mainstays of the economics of the Tabias. With regard to communication the tabias have not postal office, automatic telephone, but it has mobile telephone, electric service from the national grid hydro power, lack of trained manpower, in command rural area, there are two rural Tabias; their major economic activities are mainly related to selling and buying agricultural products and petty trade of consumable goods. Economic activity related to traditional agricultural production. Economic activity related to traditional agricultural production. Most of the project area residents have to travel 18 and 33.8 Kilometer Nebelet town and Edaga_Arbi town respectively to get market services. This command area has comprised two rural Kushit lands which are from the Adi_Rgeto and Adi_HedemTabias', which are named Adi_Ala and Adi_Hedem Kushite', those residents socio economic condition is almost similar except political administration and location difference.

7.3.1. Population Characteristics

Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), this Woreda has a total population of 146,104, an increase of 32.06% over the 1994 census, of whom 71,659 are men and 74,445 women; 16,525 or 11.31% are urban inhabitants.

A total of 32, 542, households were counted in this Woreda, resulting in an average of 1.04 persons to a household, and 31,090 housing units. Whereas the total population of Werie_ lek based the administration information, the Woreda has 186,533, among whom 91,498 are male and 95,035 are female. While come to the command area population, Adihedem Tabia has totally 5,264 among which 2,579 are male and 2,686 are female, in household, there are 1,006 household head are counted in Tabia, among whom 651 are male household headed and 355 are female households headed. In Adi_Regeto, it has 3,668 populations, out of which, 1,813 are male and 1,855 are female. This Tabia has 802 households, among whom 524 are male household heads and 278 are female household heads.

7.3.2. Land holding

The land holding size of households ranges from 1.5 hectare to 0.5 hectare. Consequently, promotion of an intensive farming system through increasing use of appropriate agricultural inputs, the productivity of land is the only means to alleviate existing population pressure and problems of food security. Land preparation is done by using the traditional way of plow drawn by a pair of oxen. This process is carried out in order to manipulate the soil for better contact between seed and soil moisture, preparation of a suitable medium for root growth, control of weeds, moisture conservation, and infiltration of surplus water. This agricultural practice is carried out using animal drawn traditional implement known as maresha. The hand hoe is also another most common tillage implement in the area.

7.3.3. Public Health Status and Prevalent Diseases

According to the Woreda health office the public health status in the study area, morbidity statistics reported were collected from the health office and health center. The top ten most common diseases recorded by health centers, in the Woreda and the project area is given below. Regarding to health condition and accessibility, finding of sample survey revealed that about 90.9% of total sample households replied that they have accessible to health center on average at distance two and half kilometers and 9.1 % of the total sample population are gotten health post at 4 kilometers and 2.5 kilometer

from health center and 97% the total sample population have responded that they are getting hospital services by travelling 45 kilometers from their inhabitants. In the Woreda there are 5 health centers, 21 health post, 4 rural drug shop and 1 primary hospital currently giving a service and the present health institutions ratio to the population of the Woreda is 0.74.

The majority of the main health problems are communicable diseases and this is mainly related to low socio-economic status of the population in the Tabia as well as in the whole Woreda. The leading public health problem in the Woreda is skin diseases, Pneumonia, Malaria, Acute Febrile Illness and All Respiratory Diseases are among the main. Most of the diseases are communicable diseases and closely related to shortage of clean water supply for drinking and hygiene, poor environmental sanitation, and low quality housing all related to low socio-economic status of the population. Defective and improper management of water resources also leads to production of vectors which is typical for distribution of malarial infection but here it stands tenth in the top ten disease given on the table below.

Table 7. Top ten diseases in the Woreda

No	Type of diseases	No of people affected
1	Skin infection	5983
2	Acute upper respiratory infections	5235
3	Acute Febrile Illness	4301
4	Malaria(confined with P. falciparum)	9909
5	Pneumonia	4088
6	Other or unspecified infectious and parasitic diseases	2642
7	Dyspepsia	2124
8	Diarrhea(non-bloody)	3450
9	Malaria(confined with spp other than P.falciparum)	4890
10	Trauma	2680

Source; Woreda Health office

7.3.4. Water supply and sanitation

Werie-Leke Woreda in general and the proposed pump irrigation project Chemiet area (Adihedem Tabia Administration) have not possess enough water supply coverage with respect to access, quality and sustainability. According to the Woreda Water Resource, Mining and Energy Office (2017) data only 66% of the Woreda have access to safe water supply and the main sources of water in the Woreda are SWL, HDW, and SP etc.

7.3.5. Existing Sanitation and Hygiene

Regarding to sanitation coverage in the Wereda is 70.9% according to information obtained from the health office, there are estimated about 29,435 household heads built their own latrine and 9,434 household heads without latrines. Out of the total latrine holding household heads are only 16,148(92.6%) are effectively utilizing their latrine and the resting non-users. In line with this view, health institutes are reported that as having latrine and waste pit surrounding their catchment area households of command area are. As far as waste pit utilization at the household level is negligible as per consultant observation and as share the opinions the health professional the area.

The sanitation coverage the specific proposed project area of Ruba_chiemit is 69%, the existing latrine and pit owner's household heads on Adi_Hedem and Ad_Regeto are 2,935 and 635 respectively. In regarding to solid water disposal, it is common to observe open field defecation Carcasses of dead animals remain in all residential area and around villages study area as per the observation and discussion made with all tabia chair men.

7.3.6. Energy source and fuel supply

Major energy source is fire wood as a result deforestation in the area especially around the project area has been going on for the cooking of food. Cutting of natural trees and bushes for firewood, cattle dung and residue of crops are also used as domestic energy source. The community are used kerosene, solar and electricity mainly for light and some electric device are used for cooking of food in the town. Type of technologies introduced by the woreda in the energy sector are listed in the table below;

Table 8. Energy Technology introduced in the Woreda

No	Type of energy Technologies	Number of energy technologies introduced
1	Improved stove	6991
2	Electric Midija	3785
3	Big Solar	150
4	Electric Mitad	3364
5	Small solar	15935
6	Biogas	15

Source Werie-Leke Water resource energy and mining office

7.3.7. Housing and Settlement Pattern

The settlement pattern and type houses of residents 'the project area have been different from the other zone of the Woreda, since housing construction by its nature is differ from area to area based on the material resources can be available, wealth of house owner and the climatic feature of the area. Accordingly, majority of the residents the project areas are farmers which are living on subsistence agricultural activities and animal breeding and hot climatic condition. Hence, the housing is directly and indirectly explanatory economic condition of the famers. Therefore, the houses of the proposed project have been constructed from stone materials and plastered with mud and its roofs are covered by corrugated and grass. Some house units have built with brick wall and plastered with mud and its roof is corrugated iron. Those housing have been settled in very closely related areas following right and left-wing side of the main road which passed crossed through the village center of Adi_Regeto. The Adi_Hedem resident are settle at Sekalu peak area following this mountain. Those Kebeles have been classified into sub Kebeles, its local name is known as kushit, Adi_Hedem, and Adi_Ala respectively. Accordingly, these are housing units have been found in widely scattered geographical areas in order to have access of large cultivable land and fear

malaria epidemic disease so that they settle following peak of the mountain and its mountain chains nearby villages.

7.3.8. Education

There are one complete primary (1-8) and another one primary school (1-4) schools in the in Adihedem Tabia. After completing the complete primary school, the nearest school for grades 9 to 12 is Edagahamus town which is average distance of about 6km from the proposed Chemiet pump irrigation project walk or travel round trip from their homes every day. While some students live in Edaga Arbi the Woreda capital and Nebelet the second larger town of the Woreda to follow their secondary education

Table 9. Number of students and teachers in the study area

School level	Number of students			Number of teachers		
	Male	Female	total	Male	Female	Total
Primary school (1-4)	87	78	165	3	1	4
Primary school (1-8)	484	496	980	7	14	21

Source Werie-Leke Woreda Education office

7.3.9. Economic condition of the area

The economic condition of the proposed project area is agricultural activities and the area is potential for crop production and animal rearing so most of the people around the project area use mixed farming activities for its sustained life. The project area has food insecurity problems due to the erratic nature of rainfall, drought and traditional agricultural practice for many years. As a result the community did not produce enough food for their families and are dependent on additional off farm activities as daily labour for part of the year. The proposed Irrigation project is inevitable to demand active labor forces to realization this project as predetermined schedule. The proposed project demand labor at construction and operation phases, particularly irrigation project by its nature a labor and inquire huge labor while implementing. Since Irrigation project will intend to double the cropping season is because of increasing access to irrigation during the dry seasons, the pressure on household labor is apparent.

7.3.10. Infrastructures

According to Werie _lek construction and transportation office, The study Wereda, Were_Leke, has about 371.67kilometers all-weather road and175.2 kilometer dry weather road, the only standard road in the Wereda about 34.5 kilometers from Adwa to Edaga_Rabi and 65kilometers from Abyi_Adi toEdaga _Arbi,only up to the turning point from the main road Adwa via Abyi_Adi to Edaga_Arbi (mazorla)which is the remaining 7.5 kilometers distance folding from axially asphalt road to Edaga _Arbi is gravel road.

Accordingly, the Edga _Arbi,Wereda, Administration Center is located Kilometer 168 from the regional capital and 67 km from the zonal capital, is linked by all-weather asphalt road to both town butrest of road of the Wereda, all weather and dry weather road that connected the Wereda center of Edga_Arbi with other rural townand Tabia centers. The roads that lead to Adwa, Axum Nebelet, hawzien,Abyi_ Adi are the main roads of the Wereda.

The road network of the Weredawill be tremendously change if there is currently under taking asphalt road construction activities is completed, this road isunder the provision of the Ethiopian Roads Authority to construct about totally 90 kilometer asphalt road from starting from turn place main road of Abyi_Adi via Axum to Edgar_ Rabi pass to Nebelt and Haziwn. These road have been under taking its construction by Sur construction PVt Ltd, com.

7.3.11. Ethnicity and Religion

The inhabitants of the community proposed diversion irrigation project area are totally Tigrigna speakers. The major religious followed along the proposed project site are fully the Ethiopian Orthodox but within the entire Woreda Muslim is also followed.

7.3.12. Physical and Cultural Resources

According to the data obtained on field survey there is no physical and cultural resources in the command area that could be affected by the implementation of this diversion irrigation project.

7.3.13. Livelihood

Teff and Finger Millet the crops grown around the command area while maize and sorghum are widely grown in the other Kushets of the Tabia. Mango, papaya, avocado, and orange are the perennial fruit trees grown while tomato, cabbage, and pepper are the vegetables grown by using irrigation. At tabial level, there are 3768 cattle, 8126 goats, 2341 sheep, and 1139 equines. Besides to agricultural activities, some farmers and landless youth are engaged in off-farm activities such as weeding and harvesting by migrating seasonally to Humera as well as in construction activities (within the Tabia, AbyiAdi and Armachoho places). Landless and jobless youth are organized and supported to be engaged in different income generating activities. Thus, sixty-five youth are organized into five honey producing groups consisting of 13 people each. There are 80 youth organized in sand collection and selling activities.

7.3.14. Livestock Conditions

According to the information obtained from the informants and animal science expert, Livestock production is the second most important activity after cropping. The livestock population is predominantly of indigenous stock and begayet. Most of the households in the rural areas have some connection with animal husbandry for income, food or draft power. Goat represents the highest number in proposed project followed by cattle and the produce of which has a ready market in the local areas.

According to WeredaWerie_Lek livestock experts, the total livestock population of the Wereda is 359,675 out of which 126,554 are cattle, 52,175 are sheep and 164, 132 are goats, 30 are mule and 268 are camels.

Therefore, while come to the project area, livestock production is one of the major economic activities in Ruba_Chieimit project area and the number of animals still is a symbol of wealth among farmers, the estimated livestock population in proposed projects is 19,848. Out of which 7,366 are Cattle, 5,287 are goats, 6,181 are sheep, 6 are camels and 1,021 are donkey. Animals feeding by keeping at home compound, in semi natural wood and shrub land, and on stubble of harvested crops. Most of the soils are cultivated with teff, sorghums and other crops are not available for grazing. Due to low

feed availability the output per animal is very low. As compared to other animal types, goat is best adapted to prevailing conditions. Due to the shortage of water, low feed and inadequate veterinary services, the condition of livestock is poor. Accordingly, it is presented that the estimated livestock population of proposed project Tabias in following table below.

Table 10. Livestock population in the project area

Sr. No	Type of livestock	Live Stocks Population by Project Area	
		Command area	
		Adi_Regeto	Adi_Hedem
1	Cattle	4,942	2424
2	Goat	4,263	1,898
3	Sheep	3,227	2,060
4	Camel	6	-
5	Donkey	491	530
6	mule	-	7
	Total	6,919	12,929

Source Werie-Leke Woreda Agriculture office

7.3.15. Irrigation Practice and Experience

According to information obtained from Woreda agriculture and rural development office both areas local farmers of Werie_Lek Woreda have already been practicing rudimentary irrigation for a very long time by diverting water from rivers (in the dry season), Water (flood) harvesting and making use of shallow wells, communal well to produce subsistence food and /or cash crops. Besides, their degrees intensity of traditional irrigations is practiced in the Woreda at low level when it is evaluated against the water resources that exist in the Woreda.

Traditional irrigation has been practiced in the area where flow of rivers and streams (springs) are diverted in to crop lands through traditional means devised by the farmers, it indicates the farmers have tried to use the available water resources in the area. But it is a temporary diversion structure across the bed of rivers and canals the contours of terrains. It is exposed to loss of water such as low efficiency in utilizing the water. It results in lower yields as well as some irrigation infrastructures have

constructed by the Woreda and by individual farmers such as check dams, pond, private pond ,micro dam and diversion, according to the Woreda water resource and mining office 7,371.25 hectares have been irrigated by using 1,866 are private well, 212 are tradition water diversion , 12 are spring development, 625 are motor pumps, 10 are micro dam,42 are check dam and 59 are diversion,10 are deep wells however the schemes have some basic challenges among which are siltation, poor water user association, maintenance problem, lack technical support and prompt response of all stakeholders on maintenance and capacity buildings.

7.3.16. Gender Aspects

Ethiopia is signed the UN Convention which provided a strong basis for a policy framework to integrate gender into the social, political, economic, and legal spheres of the country. A “Women’s Policy” was formulated in 1993(EC). To facilitate policy implementation at the Federal and Regional levels the Ministry of Women and Child Affair at Federal Level and Women’s Affair Bureaus have been organized in many sectoral Ministries and in all Regional Governments. Women in the project area have faced relatively more constraints with respect to the multi-dimensional social, economic and political problems. Most of the problems seem to emanate from the social and cultural setting of the community itself. The following, among others, are key points of discrimination of women in the area observed.

- Lack of access and control over resources in the household and community specially in male headed households;
- Lack of access to play roles for leadership and decision making in the community based organizations and other institutions;
- Lack of involvement in development planning, implementation, operating, monitoring and evaluation,
- Cultural barriers that suppress women’s’ right and undermine their role in various social, economic, political and natural spheres.

8. STAKEHOLDERS AND PUBLIC INVOLVEMENT

Public and stakeholder involvement is essential element for effective environmental and social assessment, as it is for planning and appraisal of any development projects. Public participation and consultation in the partial ESIA process tends to improve project design, environmentally sound and social acceptability. Consultations were carried out with different stakeholders. Stakeholders consulted were Woreda Werie-Leke Chief Administration, Woreda Water Resource Development, Mines and Energy office, Agricultural and Rural Development office, Environment Protection Land Administration and Use office, Health office, Education office and Tabia DA and other equivalents. Furthermore, consultation was carried out at Tabia level (Adihedem Tabia) including expected beneficiaries of the proposed project 222 farmers.

Figure 4. Public consultation and participants



The main focus of the discussion was:

- Overview of the region with respect to the potential of irrigation development especially Werie-Leke woreda Chemiet river, in Adihedem Tabia.
- The woreda is prone to shortage of productivity as a result of shortage of irrigation water erratic rainfall.

- Chemiet River has a potential to the study and design of irrigation development projects to cultivate large area in the Woreda.
- Create awareness to the communities and other stakeholders about the objectives and benefits of the proposed diversion irrigation project.
- Encourage the communities and other responsible government officials in the project planning and implementation processes.

Expected project positive and adverse impacts and their proposed mitigation measures. When the project is launching there is probability of land acquisition for the construction of camp site, access road and main canals. For the purpose of these all issues at the earlier stage of the field expedition to the project area in this study, the target community groups as a primary potential beneficiaries was identified before the community rapport is made to investigate their felt attitudes towards the project. Thus, those farm families who have land holding in the proposed irrigable command area and those households that could be potentially touched with the induced effects of the project intervention was carefully selected with the help of the Kebele administration and DA assistances. Thereafter, a meeting was called at their Tabia center to make disclosures for the project and discuss points of matters that may cue up and assess the peoples' attitude and interest towards the project. Further, the community attitudes for the project were investigated through household survey and key informants interview questions in being posed to respondents this will be indicated in detail in the socio-economic report.

In doing so, community consultations, focus group discussion, key informants discussion and the Woreda stakeholders' discussions and analysis shows that generally, there are positive attitudes towards the proposed irrigation project. By the community meeting they were met for discussion. In spite of these, some participant farmers have explained their fear whether the project would dislocate/appropriate their farm land. However, little narration during the consultation session has eroded participant's spelt

threat. Otherwise, the farmers have expressed their opinions and knowledge that the project objective is very beneficial to them.

During the focused group discussion communities' attitude and interests, both households headed were assessed and they also adequately participated. In this connection they revealed that they have positive attitude towards the implementation of the project. In the consultation process, the participants assure that they will benefit from the project mainly due to the provision of dry season irrigation water. In general, the participants assured that they will take part in the project design, construction and implementation processes. They also showed their commitment to stand in line with the government policies and development strategies

9. PROJECT DEVELOPMENT ALTERNATIVES

9.1. Alternatives of “With the Project”

The most preferred alternative would be implementing the proposed diversion irrigation project with mitigation measures in place for the anticipated environmental and social impacts. This alternative is more desirable to the economy of the local community thereby promoting sustainable development and providing better livelihood which is one of the government’s primary goals. The potential impacts to the environment will also be improved by coming up with an Environmental Management Plan (EMP) that will incorporate mitigation measures. The Chemiet pump irrigation project is designed to irrigate net command area of 97 ha cultivated land to increase agricultural productivity. This helps to ensure food security, improve health and nutritional status of the community around the project area.

With the proposed diversion irrigation project the living conditions of the community are expected to get better because of availability and accessibility of irrigation water for the full season. Sustainable availability of water for full season in the command area can help the beneficiaries in generating income, creation of local job opportunities, ensure food security, reduce health problems, improve nutritional status and will have better access to market integration hence their life standard will be improved from time to time.

9.2. Alternatives of “Without the Project”

The no project activities option will lead to leaving the population in the present situation. For a region like Tigray region facing with drought and a country emerging from fighting poverty alleviation, this option is not preferable considering the need of the population to sustain their livelihood. The environmental impacts of the proposed diversion irrigation activities will be avoided, minimized in to meaningless levels and making the option desirable.

In the Woreda especially in Chemiet project area due to the erratic nature of the rain fall crop production is becoming irregular and crop failure is becoming a common phenomenon due to moisture strain. The water shortage will be continued to seriously

hinder the economic and social development and affecting the agricultural yield. In addition to this without the project things will continue with many economic and social problems like food insecurity, malnutrition, communicable diseases and with low status of economic development of the community. The purpose of this project is the economic boosting of the project command area as well as woreda by designing Chemiet pump irrigation for the cultivation of varieties of crops in 97 hectare of land at all season. Without this project, the cultivation of crops using rain fed will not be adequate with the water demand and an important shortage of productivity will be faced. The shortage of water has important environmental and social impacts on the population and the additional main purpose of the Chemiet pump irrigation development project is to permit the access to the water to the households of Adihedem Tabia. Therefore, the “without project” scenario will have a wide impact on the quality of life on the community.

9.3. Complementary Measures

The proposed diversion irrigation project can be expected to bring significant benefits to the Tabia community by improving the reliability of water for irrigation. Improving irrigation water for full season in the area can facilitate for sustainable economic development and this contributes to advance standard of living of the rural residents of the project area.

The project comprises the treatment of the catchments through soil and water conservation activities such as trench, deep trench, percolation pond, bed trench etc. This is believed to rehabilitate the natural environment of the catchment area of Chemiet pump irrigation area. Among the environmental benefits are reduce soil erosion, siltation, increase natural vegetation cover on the upper catchment. In the upper catchment area implementation of soil and water conservation are the key activities. As a result, reduced erosion, proper management of runoff and soil fertility amelioration. In addition to the above enhancement measure activities the water shed should be protect and rehabilitate by area closure, introducing zero grazing, plantation are among the major activities within the Chemiet watershed.

The Chemiet pump irrigation project will contribute to ecological sustainability of the environment because in the command area cultivation of economically advantage cash crops, fruits and cereals. Since they are green plants they can play a great role in keeping the local ecological balance. Grow crops and cereals with high capability of carbon sink, prevent the water from pollutants, and give awareness to stakeholders and community of the project area about climate resilient green economy strategy in the Tabia.

9.4. Attitudes towards the project

Communities are consulted about the importance of the project, the procedures of implementation and their participation expected. In the discussion, the people were asked about the size of land submerged by water and about the size farmers affected. After the communities have received answers that there are no lands submerged by water and no farmers will be displaced from their lands, they have showed interest on the project. Since, the project is expected to benefit many people, the local authorities and employees of government offices as well are interested, happy and eager to see the implementation of the scheme.

10. ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROJECT

10.1. Positive Impacts of the project

Chemiet pump irrigation project generally ensures production of high value crops, fruits, vegetables, cultivation of suitable multiple cropping practices in a season and maximizes the value of land. The development of this project will create short-term and long-term employment opportunities for the local people particularly for women and youth during its construction and operation phases. The following are some positive impacts of the proposed project.

Creation of Job Opportunities

Implementation of the project will provide substantial job opportunities for the unemployed local people and people coming from other places both during the construction and operation periods. This will help the unemployed people to generate cash income that will support their livelihood. Thus, it will contribute to reduction of poverty in the country especially in the project command area.

Increasing agricultural Productivity

Irrigation will ensure reliable agricultural production by avoiding or reducing crop failures due to shortage of rainfall. Crop-failures are frequent phenomena due to shortage of an erratic nature of rainfall of the area.

Improved nutritional and health status

In addition to the harvesting of cereals during the rainy season the proposed pump irrigation project helps to the community to increase productivity of their land by using the water from the diversion in the dry season and they can cultivate different cash crops such as vegetables, fruits, cereals etc. Therefore, their habits of feeding will be changed as a result of additional income from the irrigation and the variety of crops they harvest. Hence they will have access to more nutritional food. Moreover due to the additional income from the irrigation they will have better access to health service, reduce the prevalence of disease in the community, improve maternal and child health then the beneficiaries from the proposed pump irrigation project will have improved health status and wellbeing of the local community.

Improved access to infrastructure

This irrigation project designed to the developing new and upgrade selected existing irrigation scheme infrastructure on about approximately 97 Ha as identified through value chain analysis for selected commodities. The infrastructure will include irrigation infrastructure and, to a limited extent improved market facilities and rehabilitation of access roads where necessary to ensure adequate access to markets.

Capacity building of farmers

In the course implementation the pump irrigation project, farmers will be sensitized and trained on irrigation practices, irrigation water management, cooperative formation, appropriate application of fertilizer, IPM, etc. Thus communicate and develop skill transfer among the farmers to improve productivity as well as to access markets.

Increased income and poverty reduction

Reliable water supply for irrigation, is ensured by shifting from rain-fed cereal crops production to commercial high value cash crop production under irrigation combined with the application of improved farming system and agricultural inputs such as improved crop varieties, fertilizers and pesticides, irrigation will enable the farmers to produce a larger quantity and more valuable crop. This will help the farmers to generate a much better income. Improved incomes should positively affect health status and living standard by enabling the people to spend more money on clothing, housing, health and balanced diets.

Gender Equality

Like most rural places in the region, women in the study area are culturally deprived of in many important household decisions making like resource allocation and access to use, participation in important productive works and social works. Hence, involving more women in WUA committee would empower women's inferior position in household decision and would help to bring sustainable water resource use since women are more innocent, genuine and fair in managing natural resource than men can do. So the project development strongly adheres positive impact for the equality of gender.

Climate Change Resilience

Irrigation projects have beneficial impacts for the mitigation of climate change effect. It helps to improve agricultural production and productivity through supply additional water to crop production during dry season. Hence, it helps to resilience the impacts of drought effect on rain-fed agriculture activities.

Ecological Benefits

The proposed pump irrigation project will contribute to ecological sustainability of the environment because the command area will cultivate economically advantage cash crops, fruits, vegetables, cereals and these are green plants they play a great role in reducing impacts of climate change by carbon sinking activities and keeps soil moisture of the command area of the project.

Livelihood Development

SSI has multi-dimensional impacts on the livelihood development of the rural people. In this regard, an attempt was made to assess whether the irrigating farmers had been aware of the changes in their mode of life or not. Directly or indirectly, SSI has positive impact on food security, asset ownership and well-being of rural farm households; there are clear increases in agricultural production through diversification and intensification of crops grown, household income, sources of animal feed, human health improvements, and asset ownership.

10.2. Adverse Impacts and Mitigation Measures

10.2.1. Construction Stage

As the construction goes on, there will be excavations, soil disturbance and increased traffic around the site as a result of heavy trucks delivering various construction materials including construction debris. All these are likely to pollute and degrade the environment, through mud slides, noise, and dust and air pollution. Potential adverse impacts emanating from construction activities are described in detail here below.

Contraction camp Impact

The contractor will need camping site for the construction of the project. The following points should be taken in to account during the provision of land required for contractor camping.

Mitigation Measures

- The land allocated for the contractor should be land of lowest agricultural value.
- Avoid excessive clearance of vegetation in the proposed camp site
- Construct sanitation facilities and proper waste management and disposal systems for the construction workers
- Avoid open defecation around the construction site of the proposed pump irrigation and command area.

Impact: Air pollution

During site clearing, foundation excavation and site leveling, soil are likely to be disturbed and machines will be used for this purpose. The expected adverse impacts include the likelihood of air pollution and respiratory diseases as a result of dust from the site especially in the early stages of construction, air pollution from gases exhaust fume, possibility of oil spillage from machines such as; excavators, trucks, wheel loaders, etc.

Mitigation Measures

- In order to reduce the quantities of exhaust fumes, all construction vehicles will be operated according to manufacturer's recommendations and shall be properly supervised, managed and maintained in good condition and adjusted to limit the emission of smoke.
- Dust pollution will be temporal since it will be restricted mainly to the construction phase.
- All the exposed surfaces will be watered regularly and finally tarred with bitumen in order to enhance dust suppression.
- All the exposed surfaces will be paved.
- Construction workers should be use the personal protective equipments such as mask, helmet etc.
- In addition there will be speed limits for vehicles.

Impact: Displacement of people

The proposed pump irrigation project area about 97 ha will be irrigated for full season. No displacement or re-location of households or residents in the proposed pump irrigation project site.

Mitigation measures

- No mitigation measure is required because no household or residents are re-located from the proposed pump irrigation project site.

Loss of Cultivated Land

When the project is implementing there is loss of cultivated land for the construction of raising pipe, gravity pipeline, secondary and tertiary canals, and temporary access road. For the purpose of these all issues at the earlier stage of the field visit the target community groups as a primary potential beneficiaries was identified during the community consultation investigate their attitudes towards the project.

Mitigation Measures

- The farm families who have land holding in the proposed irrigable command area and those households that could be potentially touched with the induced effects of the project intervention was meticulously selected with the auspices of the Tabia administration and DA assistances.
- Since the cultivated land loss for the access road is temporarily the farmers are freely donated their lands during the construction phases of the project
- All issues rising by the beneficiaries and other affected groups will be solved by the Woreda administration and the Woreda and Tabia administrations have taken all the responsibilities to solve any questions raised by the community
- Land losses for the main and tertiary canals are insignificant and the farmers are freely donated their land holdings.

Impacts on access and traffic

The construction contractor will need to access the construction site by using public and the temporary road along the command area. Heavy and light machineries might have potential to damage the road and traffic related health problems.

Mitigation Measures

- Use traffic signals at working times and communicate with the Construction, Transport and Road office of the woreda Werie-Leke administration
- All temporary access routes on cultivated land or pasture (grassland) should be restored to their previous condition or better at the end of the construction phase.
- All construction workers on the site should be briefed on construction traffic rules and procedures.
- Awareness creation about traffic hazards should be given to students and school staffs located near the project area
- Local residents, especially children and their parents should be informed about construction traffic hazards.
- First Aid should be provided in the Tabia center for construction workers
- All accidents should be recorded and reported, with follow-up to improve procedures as appropriate.

Impact related to construction materials

According to geological survey report, the construction material was found at some distance from the pump station area. The construction contractor will require bulk these materials for the construction works like stone for stone pitching, sand, gravel, crushed rocks, etc. Obtaining of these materials will create borrow pits, vegetation destruction, flood and associated social problems.

Mitigation measures

- Site queries and borrow pits carefully to minimize impacts.
- Strip all available topsoil from borrow pits and quarries and store it safely for use in site restoration.
- Ban the use of asbestos-containing materials

Impact: Loss of Wildlife and Vegetation

The project site will not interfere directly with any existing forest reserves or national parks. However, along the raising pipeline, gravity pipeline, canals, pond station and pump stations of the structures limited loss of different species of vegetation and other bushes will be cleared so clearing of these flora affects the ecological nature of the area.

The pump irrigation project will not interfere with wildlife reserves or any protected areas but some will lead to limited movements of the wildlife such as hyena, fox, rabbit, monkey and other different birds.

Mitigation measures

- The project area has been subjected to years of human agricultural activities and as such not much flora therefore this impact will be low.
- Limit clearance of vegetation only to critical areas
- Conduct awareness campaigns among staff and community on the need to conserve nature
- Adopt strict good conservation practices, plantation and soil and water conservation around the catchment areas
- Special attention will be given to endangered species in re-plantation and rehabilitation

Impacts on water pollution

The construction of the project involves working in Chemiet River which would have potential to contaminate the water quality of the river. The construction of pump, pond, water distribution canals, and related activities may significantly cause degradation of water quality due to increase of suspended sediment and risk of residual chemical contamination from earth work and other construction activities.

Mitigation measures

- Ensure safe management of hazardous chemicals /wastes.
- Ensure safe disposal of construction spoil and other related wastes.
- Take all precautions during the refueling of vehicles, machinery and forbid the refueling near the river beds.

Impact: Public Health

During the construction of the proposed pump irrigation project different laborers and construction workers will be participate in the area. This mobile population could be bring some epidemics including HIV and AIDS which could affect not only the work force but also the local community. In addition to this problem other communicable

diseases such as malaria is also prevalent in the Tabia so that both the construction worker and the host community will be affected with malaria diseases.

Mitigation measures

- Promotion and availability of condom in the area
- Health education on HIV and AIDS and other communicable diseases to construction workers and the community as whole
- Availability of health center in the area can help in first aid service
- Distribution and use insecticide bed net to prevent from biting of mosquitoes
- Waste is collected for proper disposal at a designated area

Occupational and Safety Impacts

During the construction there may be accidents, injuries from construction activities, heavy machineries and vehicles both on the construction workers as well as on the local community. Pump irrigation construction normally takes place in the dry season which is well known for dust circulation thus posing a danger to human health.

Mitigation Measures

- Use safety materials
- Traffic indicators/signs where movement of dam truck and other construction vehicle is intensive
- Undertake watering of the area and surroundings regularly during construction stage

10.2.2. Operation Phases

Downstream water users/ flow impact

The proposed pump irrigation project will use water from Chemiet River. According to the hydrology report, the average flow/base flow of the river is calculated to be 193.25 L/sec and quantity of water to the irrigation scheme is calculated to 154.6L/sec to irrigate 97 ha command area and downstream water users flow is measured to be 48.3 L/sec which is the 25% of the base flow of the river will be released to downstream. Thus the project use significant amount of water which would not affect the downstream users and the environment.

Mitigation measures for downstream water users

- The project design should ensure availability of the minimum base flow for downstream users
- Ensure that the design has adequate design provisions to allow flow downstream even in times of dry months.
- Ensure that the minimum flow or more at all times is released downstream to maintain the ecological balance of the downstream users
- Allowing minimum base flow downstream water users 25% of the existing flow.
- Observe water right permit regulations and requirements for the sake of downstream users

Climate risk

Pump irrigation project will have advantageous impacts for the mitigation of climate change effect, the incident of climate change which is a global issue will have unintentional impact on the proposed project operation for instance, high temperature and related increased irrigation water demand, more rainfall increase in flood, or shortage of seasonal rainfall and lower water yield of the river for irrigation, exposed to pollution etc. Major climate and climate change hazards include droughts, and rising temperature loss of forest and grassland for agriculture, desertification, land degradation are some of the main causes of climate change.

Mitigation Measures:

- Supervise the conditions and suitable management of the water resources in the project influence areas and catchment areas of the proposed diversion irrigation project site.
- Proper utilization of the irrigation water during scheme operation
- Awareness creation to the beneficiaries and IWUAs of the project area
- Develop climate resilience trees and fruits in the command area of the proposed project
- Reduce climate risks by implementing intensive soil and water conservation such as trench, deep trench, percolation pond, bed trench structures
- Supported the structures by biological conservations, area closure

- Rehabilitation of degraded areas with endogenous species of trees
- Minimizing deforestation by introducing alternative energy sources such as solar, electricity and improved stoves etc.

Health impacts

Malaria is known in the proposed Chemiet pump irrigation project area and it is one of the major cause of disease in the Woreda and project Tabia. The project is likely to increase the pattern of malaria infection and other water-borne diseases such as schistosomiasis, diarrhea, etc and increase infections to STDs and HIV/AIDS associated local traders.

Mitigation Measures

- Minimize stagnant water by construction of main and secondary canals with its recommended design slopes.
- Increase awareness creation regarding sanitation and hygiene practice in the local area of the project.
- Provide and utilize of the insecticide bed net to prevent malaria infection
- Strengthen medical services to ensure rapid diagnosis and treatment.
- Working with health offices especially Tabia health extension workers.
- Strengthens the HEW on basic health extension packages and awareness creation to local community of the Tabia
- Health education on HIV and AIDS and other communicable diseases to the community

Impact of Water Pollution

The use of fertilizers and pesticides in the upper catchment cultivated land is going to be a potential source of introducing pollutants into the water. These chemicals, if applied in inappropriate manner time, it will pollute the diversion water of the command area. Excessive usage of agrochemicals (fertilizers and pesticides) by farmers have the probability to cause water pollution problems and it can affect the aquatic life and the water can be unsuitable for irrigation purposes.

Mitigation measures for water pollution

- Farmers will be trained in techniques of agrochemical applications in their farm land in the upper catchment of the project
- Agricultural extension workers and Development Agent (DA) should also be able to prepare awareness creation program on the amount and conditions for applying fertilizers and pesticides to minimize water pollution of the river.
- Stick to recommended dosage and frequency of application of agro chemicals
- Ensure recommended types of agro-chemicals are used
- Conduct awareness campaign among communities on effect of agrochemicals on aquatic life.
- Improve use of organic fertilizers such as compost at the upper catchment of the command area of the proposed project
- Introduce proper biological pest control methods and integrated pest management system

Soil fertility deterioration

Land husbandry works as well as the frequent use of cultivated land at all season and inappropriate use of fertilizer and pesticides will lead to the deterioration of soil fertility in the irrigable command area.

Mitigation Measures

- Regular monitoring of soil fertility status in the command area of the project
- Application of organic fertilizers such as compost will keep the soil fertility of the command area
- Application of appropriate and recommended fertilizer for the farmland of the command area
- Give training to beneficiaries/farmers on wise utilization and application of agrochemicals
- Introduce crop diversification of the cultivated land of the command area

Soil erosion and Sedimentation of Canals

The watershed of the proposed pump irrigation and its main canal project is not in a protected area and it is open grazing land for cattle, goats, sheep and other domestic

animals. Therefore this can facilitate soil erosion and sedimentation of the pump station and the canals. Soil erosion and environmental degradation can cause silt transportation to the weir or to the main canals and rapid siltation can occur. Therefore, this will silt up the weir and reduces the amount of water for the pump irrigation this can shortened the life span of the canals and the headwork of the proposed project and unable to irrigate the intended 97ha agricultural land in the command area of Chemiet.

Mitigation measure

- Implement soil and water conservation activities in the catchment according to the recommended watershed management plan
- Promote reforestation with native tree species well adapted to site conditions now and in the future whenever appropriate.
- Proper maintenances of conservation structures in the upper catchments
- Introduce zero grazing and area closure activities in the in the command area
- Ensure irrigation users awareness on environmental issues related to reforestation and the potential economic and social benefits of reforestation.
- Regular follow up and maintenance of the canals along the command area of the project

11. ENVIRONMENTAL & SOCIAL MANAGEMENT AND MONITORING PLANS

11.1. Environmental & social Management Plan

The Environmental & social Management Plan is an action Plan or Management Strategy for the implementation of mitigation measures identified in an ESIA. This ESMP should be implemented by several institutions, which are directly or indirectly involved in this diversion irrigation project. This Environmental Management Plan (ESMP) should have the following objectives and necessary contents:

This Environmental & social Management Plan (ESMP) has the following objectives.

- To bring the project into compliance with applicable regional environmental and social Legal requirements
- To outline the mitigating/enhancing, monitoring, consultative and institutional measures required to prevent, minimize, mitigate or compensate for adverse environmental and social impacts and/or to enhance this project beneficial impacts;
- To address capacity building requirements to strengthen the stakeholders to implement the environmental management plan.
- The ESMP should contain the following necessary contents.
- Explanation of the possible adverse impacts that the ESMP is intended to address
- List of planned mitigation measures, and how and when they will be implemented
- A description of responsibility who will implement the ESMP and a cost estimate and its source, here the cost of environmental management or monitoring plans could be nil or management (project) overhead depending on existing contracts or normal tasks of the proponent and competent authority (i.e. the source of the budget will be the government budget allotted and financed to each institution in each fiscal year and budget allotted for the project construction).

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 Tabia institution should work in collaboration. The major stakeholder at regional level would be BoA, BoEPLAU, BoWRD and BoH. Accordingly; at woreda and Tabia level all respective offices of the above mentioned institutions should participate in the process and shall be subject to the policies and procedures described in this study.

In general, to implement the ESMP smoothly, the roles and responsibilities of major implementers, selected mitigation actions for the identified impacts, as well as implementation strategies are indicated in the following sub sections.

11.1.1. Roles and Responsibilities

Environmental Management Plan (EMP) is designed to manage the environmental impacts that result from the construction and operations of the proposed diversion irrigation project in the area. The main activities of the major responsible actors are highlighted as follows:

The Environmental Regulatory body (EPLAUA): It is the Tigray region Environmental protection, Land Administration and Use Agency (EPLAUA) which act as a regional environmental Regulator (with its respective offices at Woreda levels) and responsible for the following basic activities:

- Reviewing or evaluate the partial ESIA document prepared by the consultant of the proponent
- Conduct monitoring and environmental auditing concerning the project activity.
- Based on the assessment results, setting the overall direction for the project environmental performance.

The table below summarizes how the environment will be managed during construction and operation phases of the proposed diversion irrigation project. The environmental management plan covers the summary of main environmental impacts, proposed mitigation measures, responsible body that implement the mitigation actions, and the estimated costs to implement the essential mitigation measures.

Project operational phases	Adverse environmental impacts	Mitigation measures	Specific activities to implement the mitigation measures	Unit	Quantitative amount	Budget	Time frame	Responsible body	Remark
Construction phase	Air pollution	Remove excessive clearing of vegetation for the canals	Continuous follow up during clearing the site	M ³	14730	500	Cons. phase	Contractor	
	Loss of vegetation	Limit clearance of vegetation only to critical areas	re-plantation rehabilitation	No	1500	3000	End of construction	Tabia Administration	
	Accidents and Injuries	Use full protection equipments when working	All types of PPE	No	200	500	During construction	contractor	
	Occupational and safety hazards	Advice to wear personal protective equipments	Provide PPE before construction starts such as safety shoe, helmet etc	No	200	970	Construction phase	Contractor	
	Impact related to construction materials	Rehabilitate all quarries and borrow sites	Fill and plant appropriate tree species	No	1 site	8,000	End of construction	Contractor	

	Construction camp impact	Construct sanitation and waste disposal facilities within the camp	Utilization of proper sanitation facilities and waste disposal site	No	1	20,000	Construction phase	Contractor	
	Loss of cultivated land	Canals and pipelines should be constructed economically and avoid an unnecessary excavation of cultivated land for canals	Check with design specification of the canals and pipeline strengthen supervision during construction	Km	4	5000	During construction	Construction consultant	
	Public health impacts	Provide insecticide treated bed nets to prevent malaria epidemic for construction workers	Follow up utilization of the bed net for all construction workers	No	200	5000	During construction	Woreda health office and NGOs	
Operation phase	Public health impacts	Implement health education for the community about public health problem prevention measures	Awareness creation about environmental hygiene and sanitation,	No	12	500	Monthly	Woreda EPO, health office, NGOs etc	
		Strengthens the HEW on basic health extension packages	Implement all the components of HEP by health	No	8932	2000	6 months	Woreda EPO, health office,	

		and awareness creation to local community	professionals					NGOs etc	
		Provide insecticide bed net since malaria prevalence in the woreda is common	Ensure utilization of the bed net in each households	HH	1808	10,000	Yearly	health office and NGOs	
	Impacts on water pollution	Use recommended dosage and frequency of application of agro chemicals at the upper catchment	Amount and type fertilizers and other chemicals, pesticides etc	Cn	Base on the agronomy recommendation	3000	Yearly	Woreda Agriculture and Rural development office	
		Take water quality test and identify the level of pollutants	Salinity, PH etc	Cn	Below the recommended	5000	Yearly	Water resource office	
	Impact on downstream water users	Allow adequate flow to downstream water users minimum of 25% flow	Downstream site observation	No	2	2500	Yearly	Water resource office and ARDO	
	Sedimentation and siltation of headwork and canals	Implement soil and water conservation activities in the catchment area	Physical and biological conservation activity,	Km ²	130.95	1million	Yearly	ARDO, EPO, WRDO	

			mobilizing the community						
		Re-habilitation, a forestation the catchment and affected areas	Select indigenous trees, participation of community	Km ²	130.95	9700	Yearly	ARDO, EPO	
		Introduce zero grazing in the catchment area	Arrange site guards, awareness creation to community	Km ²	130.95	5000	Yearly	ARDO,EPO WRDO	
	Climate risk in the project area	Reduce climate risks by implementing intensive soil and water conservation	Activities such as trench, deep trench, bed trench structures	Km ²	130.95	1 million	Yearly	ARDO,EPO WRDO	
		Minimize deforestation by using alternative energy sources	Introduce solar, electricity and improved stoves to the community	No	8932	1.5million	Yearly	Woreda water energy and mining office	
		Develop climate resilience and economic value fruits in the command area	Fruits such as Mango, Avocado, Orange etc	ha	97	0.5million	Operation phase of the site	Farmers /beneficiaries	
	Soil fertility deterioration	Improve soil fertility by application of organic fertilizers to keep soil conditions	Use compost and other animal manure to the command area	ha	97	9700	Yearly	Farmers /beneficiaries	
		Train farmers on	Practical	No		20000	Yearly	ARDO,	

		wise utilization of the agrochemicals in the command area	demonstration on usage of chemicals and prepare training manuals in local language	of beneficiaries				EPO	
	Water pollution	Avoid excessive usage of agrochemicals (fertilizers and pesticides) by farmers in the upper catchment of the diversion project	Demonstration on usage of chemicals and prepare training manuals in local language	No	2	20000	Yearly	ARDO, EPO	

11.2. Environmental and Social Monitoring Plan

Thus, environmental monitoring is the effective observation of site conditions and work activities; and identification of potential non-compliance situations and initiation of corrective or remedial actions. Project with potentially large, significant and uncertain environmental impacts will normally require more intensive supervision. A number of mitigation measures are outlined in the ESMP that will eliminate or reduce the negative environmental impacts of the proposed project to the acceptable levels when they are implemented. In order to see the effectiveness of the measures and to take further corrective actions for any detected impacts that may have not been identified (unforeseen impacts) during the IEE process preparing and implementing an Environmental Monitoring Plan is essential.

Monitoring is often divided into two basic categories, compliance and effects. Compliance monitoring relates to whether agreed measures are being implemented on time and to adequate standards. Effects monitoring relates to the impacts of the project on the receiving social and physical environment, and vice versa: information on these subjects assists project management to change or improve how things are being done. Therefore, the compliance monitoring will ensure that the various project organizations are implementing the provision of the ESMP effectively and on time while the effect monitoring mechanism will check on the impacts which the project is having on the physical, biological and social environment, by regular measuring of indicators. The methods used for monitoring will be observation, inspection, discussion, interview, counting or measurement.

Environmental and Social Monitoring Plan

Environmental issues/components	Parameters to be monitored	Measurement	Monitoring system	Budget (Birr)	Time frame	Responsible body
Loss of vegetation	Areas of disturbed or selected for construction	ha	Site supervision	500	Monthly	EPO, EPA, ARDO
Air pollution	Air quality, dust depletion	No	Maintenance of machineries And excavation of canals and headwork	500	Yearly	Woreda EPO, contractor
Accidents and Injuries	Frequency of injuries	No	Review of health records	1500	Yearly	woreda health office, contractor and NGOs
Safety and occupational health	Working environment	No	Review of health records	970	Yearly	woreda health office, contractor and NGOs
Water pollution	Chemical quality of water in the river	Cn	Measure the water quality parameters such as pH, salinity	5000	Yearly	Woreda EPO, EPA, ARDO, WRDO

Impacts for downstream water users	Downstream base flow	L/sec	Observation of the downstream water users	3000	Yearly	Woreda EPO,WRDO, ARDO
Public health problems	Disease prevalence of the project area	No	Review of health records	1500	Quarterly	Woreda health office, NGOs
Soil fertility deterioration	Level of salinity, land productivity	Ha	Physical, biological and chemical treatments of the soil	9700	Year	ARDB
Climate risk in the project area	Drought, crop failure	Kebelle	Rehabilitation and reforestation of the catchment area	5000	Yearly	Tigray ARDB, EPA
Impact due to construction of camp site	All wastes generated from the camp	No	Prepare proper sanitation and waste disposal facilities	2000	During construction	Contractor and supervisor, health office
Sedimentation of drainage structures and canals	Number of blocked drainage structures and canals	ha	Follow up level of conservation, reforestation of the catchment area	10,000	yearly	EPO,WRDO, ARDO

12. CONCLUSION AND RECOMMENDATIONS

12.1. Conclusion

Small scale Irrigation development aims to bring about increased agricultural production and consequently to improve the economic, social and environmental wellbeing of the rural population. Pump irrigation project plays a great role in meeting the growing demand for food and to achieve long-term food security. The high yields obtained in irrigation and other benefits such as increased incomes, employment creation, food security, are an indication that irrigation can bring sustainable agriculture and economic development without severe effect on the environment. The proposed Chemiet pump irrigation project is designed to irrigate 97ha of land for full season. However as most irrigation development project are associated with negative environmental effects this partial ESIA study has assessed the adverse impact of the proposed Chemiet pump irrigation project. Some of the adverse impacts associated with the pump irrigation project is identified during the site investigation and assessment and possible mitigation measures are proposed to halt or to minimize the adverse impacts. Hence, in this partial ESIA study impacts on physical, biological and social environment are predicted and possible mitigation measures are proposed for the identified negative environmental impacts. Then for sustainable operation of the irrigation scheme, the project shall mainstream those environmental and social management issues in its project activities and accordingly undertake regular monitoring systems as planned. The project has considerable benefits and contributes more to economy in the local area. The project is beneficial to increase agricultural yield and for crop diversification. These benefits to the community will by far outweigh the negative social and environmental impacts expected, which of course can be mitigated. By diverting water from Chini River, it allows farmers to secure crop production and therefore contributes to food security and poverty alleviation. It is proposed to develop significant area of land 97 ha using this river and benefits a minimum of 222 households in the local area.

12.2. Recommendations

To implement for Chemiet pump irrigation project the following recommendations should be considered during construction and operation phases of the project.

- For effective functioning of the irrigation scheme, close monitoring of environmental and social management plans has to be put in place.
- To downstream water users considering minimum base flow 25% water for full season is mandatory not only to downstream water users but also to the sustainability of the aquatic ecosystem of the Chemiet river.
- Training of the development agents (DA) and water user association officials are essential to building the local understanding, management capabilities and community responsiveness in using of the irrigation water
- Implementation of soil and water conservation, forestations of degraded area, introducing area closure, minimize deforestation specially in erosion prone areas of the upper catchments, is necessary because soil erosion and deforestation can cause sedimentation and siltation to the proposed irrigation structures
- Strengthen agro forestry especially species that can help in soil fertility within the command area.
- Periodic monitoring of the water quality and soil salinity should be followed, even though, the water quality of the area for irrigation purpose is suitable.
- Beneficiaries of the cultivated land or the command area have been used chemical fertilizers, pesticides and herbicides repeatedly. In the long run, these chemicals will have cumulative impacts on the environment. To minimize such impacts farmers should be trained in preparing and using organic fertilizers, like compost, use of chemical fertilizers as per the recommended amounts and use mechanical for herb and pest control methods.
- To promote ownership and sustainability of the project, encourage maximum participation of the community in all stages of project planning and design, implementation and operation.

- The establishment, strengthening organization of irrigation water users association (IWUA) and other cooperatives are very crucial that should be given attention.
- The Irrigation project must be supported by Capacity building activities like technology transfer, practical training, experience sharing, efficient market infrastructure and support services such as rural credit such as Dedebit Microfinance, and other links for the production and distribution of agricultural products.
- The program should encourage the use of environmentally friendly technologies (IPM, organic fertilizer such as compost etc) to keep soil fertility of the command area.
- The project should assist the local community by offering employment opportunities in the project activities to feel sense of ownership by the local community for sustainable use of the irrigation project.
- The Irrigation projects must be supported by efficient market infrastructure and support services such as rural credit, focused extension services, transport and communications, more affordable energy sources, ware housing and other links for the production and distribution of agricultural products
- Produce commercial crops and other economic advantage fruits and vegetables within the command area of the project
- During the implementation of a project there is always the possibility that some issues will change through time, this environmental & social management plan (ESMP) should therefore be revised where necessary to mitigate the unanticipated impacts and changes in the future.

Reference

- EPA, 2000. Environmental and Social Impact Assessment Guideline, Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia
- FAO, 2013. Environmental Impact Assessment Guideline for Field Projects, Food and Agriculture Organization for the United Nation, Rome; 2013
- MoANRM, 2016. Environmental and Social Management Framework for Participatory Small scale Irrigation Project (PASIDP), Addis Ababa, Ethiopia.
- MoARD, 2011. Guideline on Irrigation Agronomy, Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia
- MoARD, 2012. Guideline on Environmental and Social Management Framework, Ministry of Agriculture and Natural Resources Development, Addis Ababa, Ethiopia
- SDCSE, 2016, Detail Design & Study of Gombolozo Small-Scale Irrigation Project, January, 2016, Hawassa, Ethiopia
- The Federal Environmental Protection Authority (2004). Environmental Impact Assessment Guidelines on Irrigation Projects, Addis Ababa Ethiopia
- Amhara National Regional State Water, Irrigation and Energy Bureau (BOWIE) Feasibility Study and Detail Design of Challi Intake Irrigation Project Volume VI: Environmental Impact Assessment Final report Sep, 2016, Dessie