

# **ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT GUIDELINE FOR IRRIGATION SECTOR (FINAL REPORT)**

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ADDIS ABABA, ETHIOPIA**

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## ACRONYMS

AACGEPGDC	Addis Ababa City gov't Environmental protection & Green Development Commission
AAWSSA	Addis Ababa Water Supply and Sanitation Agency
AGP	Agricultural Growth Program
CBD	Convention on Biological Diversity
E.F.Y	Ethiopian Fiscal Year
EA	Environmental Assessment
EFCCC	Environment, Forest, Climate Change Commission
EFY	Ethiopian Fiscal Year
EMA	Ethiopian Mapping Agency
EMP	Environmental Management Plan/ Environmental Monitoring Plan
EPA	Environmental Protection Authority
EPC	Environmental Protection Council
EPE	Environmental Policy of Ethiopia
ESIA	Environmental and Social Impact assessment
ESMP	Environmental and Social Management Plan
ETo	Reference Evapotranspiration
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FTC	Farmers Training Center
GDP	Growth Domestic Product
GOE	Government of Ethiopia
GPS	Geographical Positioning System
HH	Household
IBC	Institute of Biodiversity Conservation
IFAD	International Fund for Agricultural Development
Mha	Million Hectares
MOA	Ministry of Agriculture
MOH	Ministry of Health
MOWIE	Ministry of Water, Irrigation and Energy
NCS	National Conservation Strategy
NGO	Non-governmental Organization
NH3	Ammonia
NO2	Nitrite

NO <sub>3</sub>	Nitrate
OBA	Oromia Bureau of Agriculture
OEFC	Oromia Environment, Forest, Climate Change Commission
PLC	Private Limited Company
Qt	Quintal
RAP	Resettlement Action Plan
SAR	Sodium Absorption Ratio
SSID	Small Scale Irrigation Development
SSIP	Small Scale Irrigation Project
SSIS	Small Scale Irrigation Scheme
SWC	Soil and Water Conservation
TDS	Total Dissolved Solids
TOR	Terms of Reference
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WHO	World Health Organization

## GLOSSARY/TERMS USED IN THE GUIDELINE

<b>Alternative</b>	A possible course of action that might be adopted in lieu of the proposal or activity or in terms of site, design, input, process, including the "no action" alternative.
<b>Audit</b>	The process through which how well compliance with policy objectives and regulatory requirements is met and the fidelity of the implementation of conditions attached to an approved environmental impact assessment report is examined.
<b>Competent Agency</b>	Any federal or regional government organ entrusted by law with a responsibility related to Environmental Impact Assessment.
<b>Cost-Benefit Analysis</b>	Objective, careful, and explicit analyses of the costs and benefits of a proposed action. Such an analysis should also determine social discount rates for both costs and benefits.
<b>Cumulative Impact</b>	An impact that may in itself not be significant but the combination of one or more impacts that can have a greater effect than the sum of the individual impacts.
<b>Environment</b>	The physical, biological, social, economic, cultural, historical and political factors that surround human beings. It includes both the natural and built environments. It also includes human health and welfare.
<b>Environmental Assessment</b>	The methodology of identifying and evaluating in advance, any impact positive or negative, which results from the implementation of a proposed action.
<b>Environmental Impact Assessment Report</b>	A report containing sufficient information to enable the Environmental Agency to determine whether and under what conditions a proposed action should proceed.
<b>Environmental Management Plan</b>	An action plan that addresses the how, when, who, where and what of the environmental mitigation measure aimed at optimizing benefits and avoiding or
<b>What is Environmental and Social Impact?</b>	Environmental and Social impacts refers to any change to the environment and the society or to its components that may affect human health or safety, flora, fauna, soil, air, water, climate, natural or cultural heritage, other physical structures, social, economic or cultural conditions.
<b>Who should undertake an environmental and social impact assessment?</b>	The proponent is responsible for undertaking an environmental and social impact assessment (ESIA) and submitting the study report
<b>Which project requires ESIA?</b>	Those projects listed in the guideline prepared by EFCCC that are likely to entail significant adverse environmental and social impacts are require ESIA
<b>To whom shall the ESIA be submitted?</b>	When the project is federal or trans-regional, its ESIA shall be submitted to the federal EFCCC. Otherwise it shall be submitted to the appropriate regional office
<b>When should be an ESIA be carried out?</b>	Undertaking an ESIA should begin at the time when the project site selection commences
<b>What shall be the content of an ESIA?</b>	An ESIA shall contain sufficient information to enable the determination of whether and under what conditions the project shall proceed.
<b>When should an ESIA be submitted?</b>	The ESIA must be submitted before commencing any construction or any other implementation of the project



## 1. INTRODUCTION

### 1.1 Background

About 70 Mha cultivable land is available in Ethiopia. From the existing cultivated area, Current irrigation schemes only cover about 640,000 ha (4 to 5 percent) across the country. This means that a significant portion of cultivated land in Ethiopia is currently not irrigated (Seleshi, Teklu and Regassa, 2010).

Over the next two decades, Ethiopia planned to irrigate over 5 Mha with existing water sources, contributing significant income per annum to the economy and ensuring food security for up to six million households (~30 million direct beneficiaries). These irrigation schemes vary widely in size and structure, from micro irrigation (RWH), to river diversion, pumping, and small or large dams, etc. These schemes can be subdivided into Small Scale-Irrigation (SSI), Medium-Scale Irrigation (MSI) and Large-scale Irrigation (LSI). Small scale-irrigation (SSI) is a community-based and traditional methods that covers less than 200 hectares while medium-scale irrigation (MSI) is a community based or publicly sponsored, covering 200 to 3,000 hectares and large-scale irrigation (LSI) covers more than 3,000 hectares, which is typically commercially or publicly sponsored. In all scales of irrigation schemes, there will be an improvement of beneficiaries' quality of life. In the long term, Ethiopia will have to sustainably expand its irrigation sector to cover a larger area by scaling up medium- and large-scale surface water schemes and exploring and developing its groundwater potential. In the short term, irrigation will be able to harness Ethiopia's considerable labor resources by creating employment opportunities (Seleshi, Teklu and Regassa, 2010).

On the other hand, unplanned irrigation implementation can create potential environmental and social aspects such as disaster risks, depletion of water sources, affects water and land resources and agricultural productivity, soil erosion, runoff and leaching of chemicals, waterlogging and salinization, incidences of waterborne and water related diseases, changes in the lifestyle of beneficiaries, and other environmental and social impacts are issues in SS, MS and LS irrigation schemes (3 & 9).

Hence, to correct the ill-effects of irrigation projects, it is mandatory to follow environmentally safe and socially acceptable ways of implementation of irrigation projects which must be followed up by the competent agencies and other concerned stakeholders through preparing guiding rules and principles to be strictly followed by developers of the projects (3) by doing ESIA study before implementation of irrigation projects.

Therefore, irrigation ESIA guideline is important to support the environmentally sound irrigation project implementation but the earlier irrigation guideline missed climate change, ecosystem services, disaster risk and grievance redress mechanisms components. This irrigation guideline is prepared to correct the gaps in former irrigation guideline in compliance with relevant national and international environmental policies and safeguard guidelines.

## **1.2 Objective/s of the guideline**

This guideline aims towards:

- Providing all interested parties with a consistent approach to irrigation ESIA (including project proponents, consultants, communities, NGOs and the authorities);
- Providing background information for the context of irrigation projects ESIA in Ethiopia;
- Assisting proponents in identifying their ESIA responsibilities;
- Assisting community and NGO groups in realizing their environmental rights with regard to irrigation projects ESIA;
- Assisting the authorities in determining their roles and responsibilities as decision-makers in the irrigation projects ESIA process; and

## **1.3 Scope of the guideline**

The scope of this guideline is limited to and applicable for all types of irrigation project/s (SSI, MSI & LSI) and it is pertinent to all regional and national levels.

## 2. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROCESSES

The environmental and social impact assessment process is an interdisciplinary and multistep procedure to make certain that environmental and socio-economic considerations are incorporated in decisions regarding projects that may impact the environment and socio-economy. The purpose of the ESIA process is to make aware and inform the responsible decision makers and the public on the environmental outcomes from implementing the proposed project. When a well-organized ESIA process is prepared accordingly, it recognized different possible alternatives, mitigation and management measures to minimize the adverse environmental and socio-economic impacts from the irrigation project is proposed.. Different stages of ESIA process are explained in below:

### 2.1. Project Identification

At project identification stage, the stakeholders are expected to come on board to perform preliminary assessments, which includes: reviewing the irrigation sector, discussing on the locality development demands and shortcomings, point out proper project proposal development and objectives of the project, identifying different potential alternatives, mitigation measures and management plans, characterize project scope, implementation and discussing on major issues to be addressed during the project preparation and application. A representative and combined team should be formed from the relevant stakeholders for the successful project preparation and implementation and to develop project belongingness<sup>1</sup>.

### 2.2. Pre-Screening

Pre-screening is a stage where the proponent and the respective environmental or sectoral agencies establish contact and hold consultation on how best to proceed with the ESIA. Undertaking a pre-screening consultation is advisable for, it saves time and fosters a mutual understanding about the requirements<sup>2</sup>.

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<sup>1</sup> Guideline on irrigation investment projects, Food and Agriculture Organization of the United Nations, Rome, 2018

<sup>2</sup> Environmental protection authority, EIA procedural guideline, series 1, 2003

## 2.3. Screening and Categorization

### 2.3.1. Screening

Screening is the process of deciding on whether ESIA is required or not. This may be determined by size (e.g. greater than a predetermined surface area of irrigated land that would be affected, more than a certain percentage or flow to be diverted or more than a certain capital expenditure).

Alternatively it may be based on site-specific information. For example, the repair of a recently destroyed diversion structure is unlikely to require an ESIA whilst a major new headwork structure may. Guidelines for whether or not an ESIA is required will be country specific depending on the laws or norms in operation. Legislation often specifies the criteria for screening and full ESIA. All major donors screen projects presented for financing to decide whether an ESIA is required. According to the ESIA directives number 2/2008, projects requiring full ESIA are reviewed at Federal and regional levels.

Different approaches to screening have been adopted by different agencies and governments in the world. Screening criteria can be derived from one or a combination of the following methods: Checklists, Sensitive area criteria, Preliminary Assessments and Exclusion lists.

### 2.3.2. Categorization

Proclamation Number 299/2002) aims primarily at making the ESIA mandatory for categories of projects specified under a directive issued by the EFCCC. The EFCCC will then review the ESIA and either approve the project (with or without conditions) or reject it.

To put this Proclamation into effect the EFCCC issued guideline, which provide details of the ESIA process and its requirements. According to this ESIA guideline projects are categorized into:

**Schedule 1:** Projects which may have adverse and significant environmental impacts thus requiring a full Environmental and Social Impact Assessment,

**Schedule 2:** Projects whose type, scale or other relevant characteristics have potential to cause some significant environmental and Social impacts but are not likely to warrant a full ESIA study and

**Schedule 3:** Projects which would have no impact and do not require an ESIA

However, projects situated in an environmentally sensitive areas such as land prone to erosion; desertification; areas of historic or archaeological interest; important landscape; religiously important area, etc. will fall under category 1 irrespective of the nature of the project. According to this guideline all project proponents and executing bodies (agencies) in the country should operate in close cooperation

with the EFCCC to ensure that proper mitigating measures are designed and implemented, especially for projects with an adverse effect on the environment. This in effect means that an Environmental and Social Impact Statement (ESIS) should be prepared by project proponents and be examined, commented and approved by the EFCCC.

The outcome of screening could be one of the following:

- No ESIA is required;
- Initial environmental and social impact assessment is needed;  
 This applied to:
  - Projects with limited impacts,
  - Projects in which the need of ESIA is unclear, and
  - Proposals with inadequate information.
- Full scale ESIA is mandatory – This applies when there is sufficient ground and significant impacts identified for detail assessment.
- Project rejected

## **2.4. Scoping and ToR of the Project**

Scoping is a stage, mostly incorporating the public and other stakeholders, potentially affected groups, considers reasonable alternatives, evaluate concerns expressed, understand the local values and determine appropriate methodologies on the project that recognizes the vital environmental concerns that should be dealt with in an ESIA. This step gives major opportunities for the participants to know about the proposed project and to extend their opinions. It may also identify similar activities taken place in the project area or identify problems that need to be solved or mitigated. It aims at identification of:

- Boundaries of ESIA studies (spatial, temporal, institutional, etc)
- Important issues of concern
- Significant effects and factors to be considered

Basic steps followed in scoping

- Develop a communication plan (decide who to talk to and when).
- Assemble information that will be the starting point of discussion.
- Make the information available to those whose views are to be obtained.
- Find out what issues people are concerned about (make a long list).
- Look at issues from a technical/scientific perspective in preparation for further study.
- Organize information according to issues (make the longer list into a shorter list).

- Develop a strategy for addressing and resolving each issue, including information requirements and terms of reference (TOR) for further studies.

Preparing the terms of reference provides a direction or roadmap for ESIA preparation and should preferably incorporate the issue and impacts that have been identified during the scoping process. The terms of reference generally will include the following issues:

- Project description
- A list of relevant ministries or agencies responsible in following the ESIA process and decision makings
- Applicable policies, laws and regulations as ESIA requirements
- Impacts, concerns and issues going to be studied
- Management and monitoring plans, and mitigation measures to be designed
- Public involvement and engagement
- Relevant key stakeholders on the project
- Schedule for completing the ESIA process
- Expected deliverables and outputs
- Budget for the ESIA
- Conclusions and recommendations

## **2.5. Environmental and Social Impact Analysis**

The purpose of undertaking environmental and social impact study is to generate sufficient information on significant impacts that enable the preparation of an environmental and social impact assessment report, which will be used to determine whether or under what conditions a project should proceed.

Environmental and social impact analysis Involves:

- Impact identification: a process designed to ensure that all potentially significant impacts are identified and taken into account in the ESIA process;
- Impact Prediction: a process designed to identify the magnitude of potential impacts, and provides the basis for the assessment of significance and
- Impact analysis: a process that helps to assess the relative significance of impacts
- Consideration of alternatives: demand, activity, location, process, scheduling, input, technology, etc.)
- Preparation of management plan (mitigation, monitoring activities)
- Preparation of contingency plan

***Assessing impacts characteristics should:***

- Be carried out with well-defined values of significance,
- Compare all feasible alternatives,
- Document the values and beliefs on which judgments are based, and
- Based on acceptable methodology, research and experimental findings.

***Impact significance criteria include:***

- Ecological importance,
- Social importance
- Environmental standards
- Statistical significance
- Experimental findings etc.

In this section, the most important environmental and social impacts from irrigation projects should be described in the ESIA report.

- Impacts on water resources
  - Water abstraction
  - Water pollution
- Impacts on air quality
  - Mobile sources, Stationary sources and Fugitive emissions
- Impacts on wildlife
  - Habitat loss and fragmentation
- Impact on ecosystem functions and services
  - Recreational functions,
  - Game species,
  - Spiritual,
  - Drinking functions
- Impacts on soil
  - Soil acidity, salinity and sodicity
- Impacts on social values
  - Human displacement and resettlement
  - Access to clean water and Livelihoods
  - Public health, Cultural and aesthetic resource
- Impacts on infrastructures
  - Health

- Education
- Communication
- Climate change considerations
  - CO<sub>2</sub> emissions

## 2.6. Mitigation and Impact Management

### Advantages of Mitigation Measures

- Shows better ways of accomplishing things
- Reduce or eliminate negative impacts from the project
- Increase benefits from the project
- It protects individual and public rights to compensation

### Alternatives on Mitigation Measures

- Alternative ways of attaining the needs
- Planning and design change
- Improving monitoring and management schemes
- Monetary compensation
- Replacing, relocating, rehabilitating etc.

### Impact Management Plan among other Points Should:

- Explain the proper policy, standards and legal frameworks
- Indicate environmental effects, issues and activities required to address it
- Explain schedule of activities and describe responsibilities
- Explain a standard system of reporting
- Contain a system for monitoring and auditing
- Explain financial, manpower, material and time resources requirement of the project
- Explain the proposed mitigation measures
- Prepare contingency plan etc.

## 2.7. Preparation and Submission of the ESIA Report

The final environmental and social impact assessment report should address the view points and comments from the different parties and stakeholders with the main contents as shown in Annex I:



## **2.8. ESIA Review and Decision Making**

The purpose of review is to examine and determine whether the ESIA report is an adequate assessment of the environmental and social impacts and of sufficient relevance and quality for decision making.

Reviewing can be conducted at various stages during the ESIA process, which includes:

- Screening report
- Scoping report
- Environmental and Social Impact Assessment report

When reviewing ESIA, questions to be considered includes:

- Does the ESIA fulfill requirements for the proposed activity, as set out in the relevant ESIA guideline ToR?
- Does the ESIA focus on the issues that most concern the community?
- Does the description of the existing environment reflect actual conditions?
- Has the ESIA defined the area of direct and indirect influence of the project?
- Is the impact analysis clear about the extent and significance of the impact? Is the analysis rigorous enough?
- What sources support the conclusion? Can they be verified?
- Is there enough information about the alternatives to the project?
- Is the ESIA clear and easy to understand? Does it acknowledge limitations and difficulties?
- Does the ESIA describe how the project would implement proposed mitigation and management measures (including pollution control measures and closure)?

A decision to approve or reject projects is generally based on the environmental and social impact assessment report. The decision may be accompanied by filling an environmental and social management plan. Decision making should be consultative, participatory and influence others to behave responsibly in a sustainable manner.

### **Possible decisions include:**

- Approval of the ESIA or performance reports at various stages in the process
- Approval of the implementation of the proposal with or without conditions
- Approval subject to ongoing investigation
- Request for supplementary or new ESIA report
- Rejection

## **Important consideration of decision making**

- A summary of evaluation is made available to the public
- Reasons for decision and conditions of approval are made public
- There is the right of appeal against decision
- Approval can be reversed or permit can be canceled on the advent of changing circumstances
- Approval of a proposal cannot immune the proponent from being accountable of the occurrence of adverse significant impacts in the course of the implementation of the project
- Approval of ESIA report is only describes simple agreement to the proposal. The conclusion of the approval procedure will be the issuance of an Environmental Clearance Certificate (ECC).

## **2.3. ESIA Implementation Follow-Ups**

Follow-up is a continuous observations, measurements and evaluation of changes that relate to the proposed project. It can help to follow changes over a period of time, to assess the efficiency of mitigation measures and to capture unforeseen environmental impacts of the project. Some impacts may need ongoing monitoring in all phases of the project. ESIA follow-up is conducted by project proponent, environmental regulators, local administration, affected community and other concerned stakeholders.

Provided all policy, regulatory requirements and full ESIA report, and obtained permission, development will precede following the decision. During the implementation process, follow ups and monitoring of the implementation is the vital part of the project. This will have the following importance in the process of project implementation:

- Make certain that the necessary mitigation measures are being implemented
- Checking the effectiveness of the mitigation measures
- To realize and optimize the benefits expected
- Certify the accuracy of models and projections that were used during the ESIA process
- Provide information for a periodic review and alteration of impact management plan and enhance environmental and social protection through good practice at all stages of the project

It is therefore necessary that:

- Environmental management system, including internal monitoring schemes established
- External audit conducted
- Mechanism for regular risk communication designed etc.

The summary of ESIA processes are presented in the **Error! Reference source not found.** below.

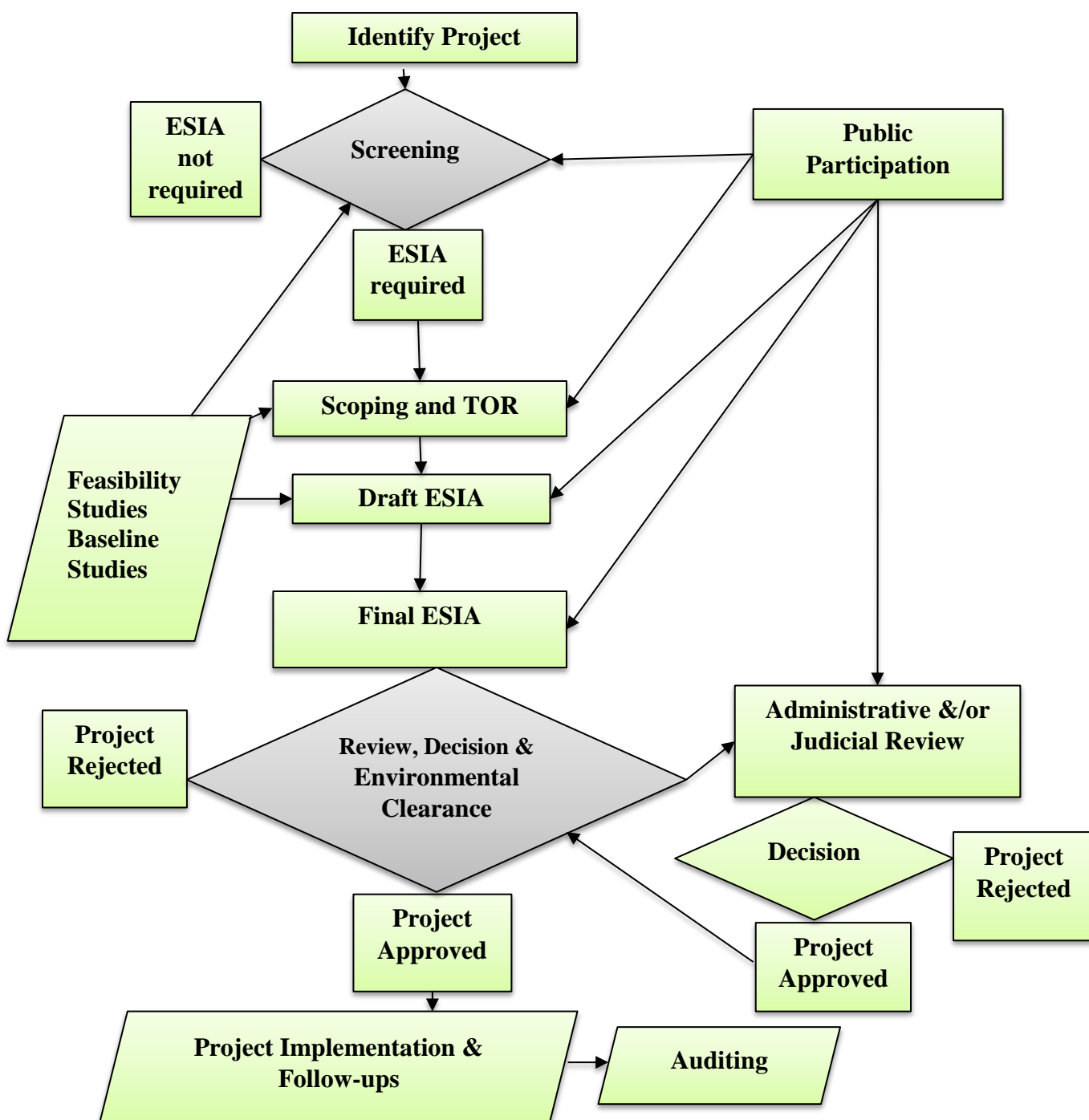


Figure 1: Summary of the basic elements of Good ESIA practice

### 3. POLICY AND LEGAL FRAMEWORKS

All policies, proclamations and strategies explained in this section describe irrigation activities/projects in relation to environment and socio-economy.

#### 3.1. The Federal Democratic Republic of Ethiopia Constitution

The Federal Democratic Republic of Ethiopia constitution in 1995 provides the overriding principles for all legislative frame-works in the country. The concept of sustainable development and environmental rights are enshrined in articles 43, 44 and 92 of the Constitution of GOE.

Article 43: The Right to Development identifies peoples' right to:

- Improved living standards and to sustainable development; and
- Participate in national development and, in particular, to be consulted with respect to policies and projects affecting their community.

Article 44: Environmental Rights, all persons:

- Have the right to a clean and healthy environment; and
- Who have been displaced or whose livelihoods have been adversely affected as a result of State programs has the right to commensurate monetary or alternative means of compensation, including relocation with adequate State assistance.

Article 92: Environmental objectives are identified as follows:

- Government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment.
- The design and implementation of programs shall not damage or destroy the environment.
- Government and citizens shall have the duty to protect the environment.

#### 3.2. Environmental Policy of Ethiopia

The Environmental Policy of Ethiopia (EPE), issued in April 1997 consists mainly of guiding principles and various sectoral and cross-sectoral policies for sustainable environmental and social management. It seeks to ensure the empowerment and participation of the people and their organizations at all levels in environmental and social management activities, raise public awareness and promote understanding of the essential linkage between environment and development.

The policy states that environmental and social impact assessments could be consider not only physical and biological impacts but also address social, socio-economic, political and cultural conditions; and public and private sector development programmes and projects recognize any environmental impacts early and incorporate their containment into the development design process (Section 4.5 ( a & b)). As most large and medium scale irrigation potential is located in the rangelands of the lowlands occupied by pastoralists, to consider the opportunity costs of irrigating important dry season grazing areas of the pastoralists for crop production in any cost benefit analysis of such irrigation projects (Section 3.4 (e)).

### **3.3. Disaster Risk Management (DRM) Policy**

The Government of Ethiopia has endorsed a comprehensive DRM policy, based on lessons learned from previous experience. The new DRM policy provides direction for the kind of DRM system envisaged for Ethiopia in the future. Such a system is based on an enabling policy environment and strategy. It relies on organizational structures with appropriate and harmonized roles and responsibilities at federal, regional, and woreda levels. Horizontal and vertical coordination among decision-making bodies and effective DRM systems, processes, and procedures is ensured.

Furthermore, the system is based on an understanding of disaster risks; on practical and targeted information flows for decision making and community DRM; on resources preparedness, ensuring appropriate and timely availability of key resources; on adequate implementation capacity, including resource delivery; and on mechanisms for learning lessons and feeding into planning and decision-making.

### **3.4. Water Resource Management Policy (2001)**

The policy ensures water allocation for water abstraction, water supply and sanitation as the highest priority while apportioning the rest for uses and users that result in highest socio-economic benefits. The policy also recognized the allocation of water for livestock as well as for environment reserve is also regarded as a priority area in any water allocation. Furthermore, the irrigation policy was stated under section 2.3.2 of this policy. The overall objective of irrigation policy is to develop the huge irrigated agriculture potential for the production of food crops and raw materials needed for agro industries, on efficient and sustainable basis and without degrading the fertility of the production fields and water resources base.

### 3.5. Health Policy of Ethiopia

The health policy under Article 3.4 stipulates the need to develop safe disposal of household agricultural and industrial wastes, and encourages the recycling of waste. This policy under Article 5.3 also indicates the need to prevention of environmental pollution from hazardous chemical wastes.

### 3.6. National Biodiversity Strategy and Action Plan

The current Ethiopian Biodiversity Strategy and Action Plan (EBSAP) of December 2005 will address interlinked issues comprising biodiversity protection and management. The goal of the Ethiopian Biodiversity Strategy and Action Plan has been formulated as “Effective systems are established that ensure the conservation and sustainable use of Ethiopia’s biodiversity, that provide for the equitable sharing of the costs and benefits arising therefrom, and that contribute to the well-being and security of the nation.”

Ethiopia’s biodiversity conservation priorities are found in the four strategic objectives then followed by the specific objectives:

- Representative examples of Ethiopia’s remaining ecosystems are conserved through a network of effectively managed protected areas.
- By 2020, all remaining natural ecosystems outside of the protected areas are under sustainable use management.
- The costs and benefits on biodiversity conservation are equitably shared through a range of public, private, community/CBO and NGO partnerships for PA management and for sustainable use and marketing of biodiversity.
- The rich agro-biodiversity of Ethiopia is effectively conserved through a mix of in situ and ex situ programs.

### 3.7. Ethiopian’s Climate Resilient Green Economy Strategy

The Government of Ethiopia has planned a climate-resilient green economy as a development strategy. This development direction promotes environmental protection, reducing fossil fuel consumption which releases greenhouse gases into the atmosphere. With demand for energy growing with the increasing population, industrialization and urbanization, the government realized that harnessing clean and renewable energy sources such as wind, solar, hydro and geothermal energy sources was critical.

It has indicated that these natural resources would deliver electricity at virtually zero GHG emissions. The generated electricity is a fundamental enabler of modern economic development, from powering

cities and fuelling industrial activity to pumping water for irrigation purposes in agriculture. The government also decided to increase its income through exporting electric power generated from clean sources to neighboring countries.

### **3.8. Environmental and Social Impact Assessment (Proclamation No. 299/2002)**

This Proclamation (No 299/2002) aims primarily at making the ESIA mandatory for categories of projects specified under a directive issued by the EFCCC. The law specifies the projects and activities that will require an environmental and social impact assessment (ESIA). The proponent of the project must prepare the ESIA following the format specified in the legislation. The EFCCC will then review the ESIA and either approve the project (with or without conditions) or reject it. The Proclamation requires, among other things:

- Specified categories of projects to be subjected to an ESIA and receive an authorization from the EFCCC or the relevant regional environmental agency prior to commencing implementation of the project.
- Licensing agencies to ensure that the requisite authorization has been duly received prior to issuing an investment permit, a trade or operating license or a work permit to a business organization.
- The EFCCC or the relevant regional environmental agencies may issue an exemption from carrying out an ESIA in projects supposed to have an insignificant environmental impact.
- A licensing agency may suspend or cancel a license that has already been issued where the EFCCC or the relevant regional environmental agency suspends or cancels environmental authorization.

According to this ESIA guideline, irrigation projects are categorized into three schedules:

**Schedule 1:** Projects which may have adverse and significant environmental and social impacts thus requiring a full Environmental and Social Impact Assessment

**Schedule 2:** Projects whose type, scale or other relevant characteristics have potential to cause some significant environmental and social impacts but are not likely to warrant a full ESIA study

**Schedule 3:** Projects which would have no impact and do not require an ESIA

However, projects situated in an environmentally sensitive areas such as land prone to erosion; desertification; areas of historic or archaeological interest; important landscape; religiously important area, etc. will fall under category 1 irrespective of the nature of the project.

According to this guideline all project proponents and executing bodies (agencies) in the country should operate in close cooperation with the EFCCC to ensure that proper mitigating measures are designed and implemented, especially for projects with an adverse effect on the environment. This in effect means that an Environmental and Social Impact Statement (ESIS) should be prepared by project proponents and be examined, commented and approved by the EFCCC.

### **3.9. World Bank Environmental and Social Policy for Investment Development Project Financing**

This Environmental and social policy for investment development project financing sets out the mandatory requirements of the Bank in relation to the development projects it supports through investment development project financing.

The ten Environmental and Social Standards (ESS) establish the standards that the Borrower and the development project will meet through the development project life-cycle, from (ESS 1- ESS 10) as follows:

- Environmental and Social Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Environmental and Social Standard 2: Labor and Working Conditions;
- Environmental and Social Standard 3: Resource Efficiency and Pollution Prevention and Management;
- Environmental and Social Standard 4: Community Health and Safety;
- Environmental and Social Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement;
- Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Environmental and Social Standard 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities;
- Environmental and Social Standard 8: Cultural Heritage;
- Environmental and Social Standard 9: Financial Intermediaries; and
- Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure.

Borrowers and development projects are also required to apply the relevant requirements of the World Bank Group Environmental, Health and Safety Guidelines (EHSGs). These are technical reference documents, with general and industry specific examples of Good International Industry Practice (GIIP).



### **3.10. United Nations Environment Programme**

The United Nations Environment Program (UNEP) is the leading environmental authority in the United Nations system. UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

UNEP re-organized its work program into six strategic areas (Climate Change, Post-Conflict and Disaster Management, Ecosystem Management, Environmental Governance, Harmful Substances and Resource Efficiency/Sustainable Consumption and Production) as part of its move to results based management. The selection of six areas of concentration was guided by scientific evidence, the UNEP mandate and priorities emerging from global and regional forums.

### **3.11. Labour proclamation No. 1156/2019**

It is essential to ensure worker-employer relations are governed by basic principles of rights and obligations with a view to enabling workers and employers to secure durable industrial peace; sustainable productivity and competitiveness through cooperative engagement towards the all-round development of our country; whereas, there is a need to create favorable environment for investment and achievement of national economic goals without scarifying fundamental workplace rights by laying down well considered labour administration; and determine the duties and responsibilities of governmental organs entrusted with the power to monitor labour conditions; occupational health and safety; and environmental protection together with bilateral and tripartite social dialogue mechanisms.



#### **4.1.2. Regional Environmental Agencies:**

In the sphere of local government, guiding principles need to be developed for the type and level of skills required for effective decision making by local authorities when integrating environmental issues into strategic planning and land use decisions. The guiding principles should include knowledge of the processes involved in the ESIA processes.

In the ESIA Process the regional environmental agencies or their equivalent Competent Authority are responsible to:

- Adopt and interpret federal level EA policies and systems or requirements in line with their respective local realities,
- Establish a system for EA of public and private projects, as well as social and economic development policies, strategies, laws, or programs of regional level functions;
- Inform EPA about malpractices that affect the sustainability of the environment regarding EA and cooperate with EPA in compliant investigations,
- Administer, oversee, and pass major decisions regarding impact assessment of:
  - project subjects to licensing by regional agency
  - project subjects to execution by a regional agency
  - project likely to have regional impacts

#### **4.2. Proponent**

A propont is any legal person that initiates a project, policy or program, that is, if in the public sector an organ of government, and the private sector an investor.

A proponent is required to:

- proactively integrate an environmental concerns into its social and economic development project, program, policy, plan or strategic initiative as per the requirements of relevant environmental laws and directives,
- ensure that positive effects are optimized and strive to promote conservation based development and work with objectives of continuous improvement,
- initiate the ESIA process and create the necessary ground for undertaking ESIA,
- appoint an eligible independent consulting firm who shall seek to undertake ESIA , and
- Cover all expense associated with the Environmental Impact Assessment.

### 4.3. Consulting firm

The competent authority is mandated to consider the level of expertise of the practitioner. There should be no difference between the level of expertise of the practitioner compiling the report and making the recommendations; the practitioner reviewing the report, and the practitioner evaluating the report and making decisions. All practitioners need to demonstrate substantive knowledge (training), skills and competence (experience) and ethics (values) relevant to the level of complexity, scope and scale of an activity. The firm that will be appointed to work on behalf of a proponent is expected to:

- have the expertise in environmental impact assessment and management commensurate with the nature of the proposed activity and legal requirements,
- make available an interdisciplinary team, having solid technical skills and legal
- Know-how, and local knowledge,
- Conduct the ESIA at specific project site organizing the relevant the team of expert
- Collect real data by using tools (pictures , sounds Videos, etc..) and conduct
- Stakeholder's consultation at project implementation site
- manage the participation of interested and affected parties in acceptable manner,
- have the facility to produce sensible reports that are through and informative,
- declare and ensure at all times that has no vested interest in the proposed activity and observe all ethical values of the calling,
- familiar itself with legal and technical requirements of all the concerned bodies, and provide additional detailed information related to the environmental impact study report as may be requested,
- ensure that Interested and Affected Parties are provided with all means and facilities (e.g. notice, assembly holes, reasonable time, understandable language, fair representation, etc.) enabling them to adequately air their views and concerns,
- fulfill that they are legally registered and licensed to conduct the task,
- capable of presenting sector related and an authentic complete CV of experts to be involved for the task,
- Present a true, pragmatic, analytical, understandable, and impartial account of the proposed activity, etc.

### 4.4. Interested and Affected Parties (IAPs)

Interested and affected parties are individuals or groups concerned with or affected by the proposed activity or its consequences. These may include local communities, the work force, customers and consumers, environmental interested groups and the general public.

Interested and affected parties are expected to:

- provide comments at various stages of ESIA with reasonable time frame,
- work in partnership with Environmental Agencies and proponents,
- act and lobby in good faith, knowledge, reason and in a cooperative manner and use all means and facilities to ensure fairness in ESIA administration,
- follow and monitor changes and inform the environmental and sectoral agencies and local administration the occurrence of adverse incidence or any other grievance in the course of implementation of a project or public instruments,
- Advocate and uphold the principle and values of environmentally sustainable development, etc.

#### **4.5. Licensing Agency**

Licensing agency is any organ of government empowered by law to issue an investment permit, trade or operating license or work permit or register business organization as a case may be.

Licensing agencies are required to:

- ensure that prior to issuing their respective licenses and permits, have legal duty to require proponents to submit authorization, a letter of approval or environmental clearance certificate awarded by the appropriate environmental agency,
- ensure that environmental performance criteria are included in their respective sectoral incentive or disincentive structure,
- ensure that renewal or additional permits issuance should also consider integration of environmental concerns,
- Seek advice or opinion from the appropriate environmental agency, etc.

#### **4.6. Public and Stakeholder Consultation**

There are a number of potential role players in an ESIA. The main ones are the proponent, consultant, interested and affected parties and the competent agency (EFCCC, 2000). Stakeholders and public consultations aim in ensuring the quality, comprehensiveness and effectiveness of the environmental and social assessment of a project and also considerations of interested and affected parties views and concerns. The approaches can be through public meetings, focus group discussions, meetings of

which minute with signatures and participants lists should be annexed. Therefore, to have views and consents of the project stakeholders:

- Arrange or have appointment for stakeholders' representative consultation.
- Represent the consultative meetings participants from different community groups; from government officials, youth, women, elders, local council, NGOs and project beneficiaries together at local level.
- List community representatives' consultation participants' names, institutions and telephone using registration form.
- List stakeholders' consultation participants' names, institutions and telephone using registration form
- Assign a report writer of the meeting,
- Introduce the consultative meeting Agenda
- Introduce the project and its expected components,
- Take pictures of the consultative meetings as much as possible,
- Conduct consultation with the local government key sectors officials with the selected community representatives of the project beneficiary communities of the project,
- Discuss on the project possible benefits and list them down,
- Discuss on the project possible threats or adverse impacts and list them down clearly,
- Discuss on possible mitigation measures which help in minimizing or optimizing possible project impacts and list one by one.
- Evaluate and summarize the existing or expected potential environmental and social issues that will likely arise with the proposed project implementation and gather important information on the project benefits, expected negative impacts, extent of expected negative impacts and recommend possible mitigation measures as much as possible.
- List down participants' views, attitudes towards the project and understanding including their recommendations regarding the irrigation project.
- Discuss on the level of beneficiaries and community participation and contributions in the process and implementation of the project
- Sign, stamped and annex minute and list of participants to the ESIA report.

The detail approaches and procedures concerning public and stakeholder consultation can be obtained from EFCCC (public consultation guideline in ESIA process 2018).

## 5. PROJECT DESCRIPTION

### 5.1. Detail project description

The environmental expert and the ESIA study team should describe the proposed irrigation project including the following information not limited to:

#### Location and accessibility

- Project location by Region, Zone, Woreda and Kebele/s of the project,
- Geographical location or coordinates in range
- Accessible roads taking to the project site by type (asphalt, gravel, dry weather road, or no accesses).
- Project site from each center (from the country capital, regional capital, woreda center and the kebele office, etc. as much as possible).
- Identify, if there exists any, inaccessible conditions, if there exists gorge, river crossing the project command area, etc. for example and think for the solution which you may include in mitigation measures.
- Describe advantage and/or disadvantage of the project to the area.
- Project location map (geo-referenced map of the area), slope map and watershed, showing the irrigation area, irrigation layouts (diversion site or water sources, main canal, primary, secondary and tertiary canals), road/s, villages, school/s, Farmers Training Centre (FTC), etc.

#### Head work characteristics

Describe the headwork type, location and conditions of the irrigation project.

- Type of weir or head work & sites
- Diversion weir width of \_\_\_\_ m,
- Ogee spillway height of \_\_\_\_ m, and
- Abutment height of \_\_\_\_ m
- Weir site location or coordinates; (\_\_\_\_0N, \_\_\_\_ 0E) in UTM and
- Altitude in \_\_\_\_ m.a.s.l.
- The diversion canal extension and direction west, east and preferably to the right or left of the river course shall be briefly discussed.

#### Irrigation related dam cases and characteristics

The irrigation development projects can involve dams for which, information and components of the dam are described in order to address impacts related to each in the impact assessment and mitigation measures recommendation section.

Issues which should be described at minimum with regard to the dam project are:

- Dam location,
- Off take and scheme layout;
- Water source and options;
- Micro dam project area of influence;
- Command area (ha) characteristics and area of influence,
- Population and households (HH) of the project area,
- Number of households (HH) involved or to be involved in the scheme,
- Type & purpose of irrigation infrastructure (weir, dam, inundation area, etc.),
- Crops to be grown,
- Estimated yields,
- Agrochemicals to be used, application methods and amounts,
- Ancillary infrastructure (access roads and accessibility, sheds, camps and offices, sanitation facilities, power supply).

Similarly, the dam components such as dam type (rock fill, concrete or earthen), height from crest to foundation, crest length, spillway weir, reservoir volume (m<sup>3</sup>) and inundation area, etc. must be described as impacts related to these components shall be accessed in the impact assessment and mitigation measures section.

### Project infrastructure

The irrigation projects can have different infrastructure, such as camp, an office, canal networks, access roads, etc. Therefore, describe the project infrastructure and identify:

- **Camp and office with their possible areas (if possible),**
  - ✓ Where to construct,
  - ✓ Other possible construction site in order to use the site for the intended irrigation,
  - ✓ Write down the area in hectare under infrastructure built up,
  - ✓ What possible effects the infrastructure will have on your irrigation activities, and list down possible solutions or mitigation measures for possible solution, etc.
- **Canal networks:** The main canal/s, secondary canals, tertiary canals,
  - ✓ Indicate length and width (km x m) for each canal system and convert to hectare which the land loss by the canal networks.
- **Drainage canal/s:** Drainage canals are required to accelerate removal of water during flood events, maintain groundwater levels so as to avoid waterlogging and drain surplus irrigation water. Therefore; know your project drainage network with their



sizes; Indicate length and width (km x m) of each drainage canal networks and convert in to hectare.

- **Canal crossing culverts:** Know number of culverts, site options, etc. and include the land loss by culvert construction.
- **Service roads:** To properly implement construction and operation activities of a Irrigation project activity/s, service roads shall be constructed starting from the weir site, along canal networks including drainage canals. Therefore; identify the sizes of each service road in km and m and convert to hectare.

### Command area by slope distribution

Describe the project:

- Command gross and net areas.
- Command area by slopes (less than 5%, 5-8%, 8-12%, 13-15%, 15-20%, 20-30%, 30-60%, >60%, etc. Understand that areas with less than 5% slope do not need on command area conservation measures. But those command areas above 5% need on command area conservations measures for example: soil bunds with elephant grass strips for command areas with 5-12% slopes;
- Bench terraces with multipurpose trees which do not influence the intended irrigable crops on edges of terraces to protect terrace edges sliding shall be recommended later under the mitigation measures part.

### Project catchment characteristics

Describe catchment characteristics on:

- The land use type of the project catchment area (you may have the catchment map as much as possible),
- Total area of the project catchment,
- The geographical locations (in UTM preferably) in range of the catchment
- The altitudinal range of \_\_\_\_\_ to \_\_\_\_\_ m.a.s.l.

### Project beneficiaries and affected peoples

Beneficiaries will be decided based on existing irrigation land distribution rules and regulations of the country and record or data shall be obtained from the woreda line sector:

- Indicate number of beneficiary and affected households and population in males and females, and
- Estimate the total direct beneficiary populations, and

- List number of project affected households.

## 5.2. Analysis of Project Alternatives

This portion presents summary of main project alternatives for comparing with the do-nothing or no-action scenario to avoid the likely impacts on the environment and socio-economy. The primary purpose of conducting an ESIA is to ensure that the environmental and social effects of proposed activities are adequately and appropriately considered before decisions are taken. Evaluated information and supporting arguments enable decision makers to evaluate the overall impacts of a project proposal and its alternatives. Based on the ESIA principles (EFCCC ESIA Guideline, 2000) and EFCCC procedural guideline series 1 (EFCCC, 2003), project alternatives can refer to any of the following, but are not limited to:

- Alternative location or sitting diversions, dam and its reservoirs, or pump sites,
- Alternative site layouts,
- Alternative designs,
- Alternative technology,
- Alternative processes or sources materials, and
- “No action” or “no-go”. Few of the alternatives are briefly described below.

### **Sitting or locating head work or Diversions sites or Dams and their Reservoirs, or Pump sites:**

The dams, diversions and pump sites are at appropriate sites as they are at relatively narrow, can accommodate water and easily provide for the intended development purposes. Therefore, the proposed dam sites, reservoir areas, diversion and pump sites are recommended sites.

**Alternative site and layouts:** Project site and layout alternative is selection options with least environmental and social impacts that excludes ecologically sensitive areas along main, primary, secondary and tertiary canal networks, access roads, command area and plots layout design based on the project scale.

**Alternative Designs and Layouts:** Design options can be considered as one of the best alternative in avoiding adverse environmental and social impacts of the development proposals such as micro dams, diversions and pump projects without compromising the objective of the projects. Technical, environmental and social issues are considered in comparing different designs.

**Alternative Technology:** Under the alternative technology, sprinkler irrigation or pressurized and furrow irrigation are focused. Sprinkler or spray irrigation applies water to the entire irrigated area via a pressurized pipe through single or multiple nozzles. Furrow irrigation is a small, evenly spaced,

shallow channel installed down or across slopes of irrigation fields to irrigate parallel to row direction. Fertilizers inputs, chemical inputs, waste management, energy management and machineries and other materials input alternatives should be clearly investigated in terms of environment and socio-economic benefit with detail justification.

**“No action” or “no-go” or without project scenario alternative.** The ‘without project scenario’ would mean use of the site underutilization of existing resources. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interfering with the existing environmental and social conditions and avoiding any further adverse impacts associated with the project.

The ESIA study team, should consider the best alternatives among the following by comparing their potential environmental and social impacts, capital and operational cost, suitability under local conditions, institutional needs, training and monitoring requirements.

## 6. BASELINE ENVIRONMENT

An environmental baseline study should clearly demonstrate the physicochemical, biological, ecosystem functions and services, climate change condition, socio-economic baselines and existed disaster risk occurrences. The details are presented as follows:

### 6.1. Physicochemical environment

The baseline physicochemical information to be collected are:

#### 6.1.1. Topography

The up and down topography with cut offs and slopes accelerates soil erosion hazard. Such topographic are with slopes easily expose to soil erosion. Therefore, overall topography of the project area and the describe that of the project command area as flatness or slope conditions that can affect the command area in aggravating soil erosion due to undulated or steep slope characteristics, and project command area slope distribution need to described .

#### 6.1.2. Geology

Geology influences water resources of an area and has effect on water quality, source of sediments, ground water resources and soil formations. As a result, geological investigation is very important factor in environmental and social impact assessment (ESIA) study of an irrigation development project. Therefore, briefly describe the geological characteristics of the project area.

#### 6.1.3. Climate and meteorology

Climate and metrological baseline condition to be describe are:

- Temperature, in mean maximum and mean minimum; highest and lowest temperature recorded months of the year, mean relative humidity, sunshine hour, wind speed, radiant and evapotranspiration
- Describe the rainfall (mm) of the project area as calculated mean total, annual precipitation and monthly distribution with highest rainfall and dry months (indicate data source).

#### 6.1.4. Soils

Soil related problems in irrigation projects are classified into three; waterlogging, salt building on irrigated land and crops wilting or drying up as a result of change in soils characteristics. It depends on the area topography, soil types and chemical compositions. Having this in mind the following baseline contents should be included:

- Major soil types, catchment area soil, soils infiltration rates, soil erosion conditions (as an indicators for environmental degradation), soil depth and Soil textures, Soil acidity or alkalinity (based on pH laboratory result),
- Ground water table level and water logging conditions, obtain the samples analysis result and calculate the soils; SAR.
- Considering identified soil test parameters produce soil suitability map as much as possible, etc. and integrate indigenous knowledge whenever you may face laboratory access problems.
- Soil physiochemical test (including but not limited to pH, sodium, calcium, potassium, magnesium, cation exchange capacity).

### **6.1.5. Hydrology and water resources**

Diverting water for irrigation affects watersheds by altering rivers' flow regimes (patterns of flow volume) and affecting depth of water table (USAID, 2002). Without irrigation, rivers may experience large seasonal variations, flooding during the rainy season (flood regime) and carrying small water volumes during dry seasons (low-flow regime).

- Describe major surface water sources such as rivers, springs, wetlands, lakes, etc. of the project area.
- Describe in depth the water source on which the intended irrigation project is proposed as:
  - Estimate discharge in l/sec of the river and its total annual discharge,
  - Irrigation water requirement,
  - Calculate the river water balance at diversion or weir site,
  - Evaluate downstream environmental release of the river at diversion site.
  - Assess any tributary entering into the river at immediate downstream.
  - Identify the discharge of tributary water sources which enters into the river course below the diversion site and
  - Describe downstream river discharge with tributary and evaluate possible impacts on downstream water users.

### **6.1.6. Water quality**

Irrigation activities can affect downstream water quality by reducing the amount of water available to dilute contaminants and by potentially increasing agrochemical pollution (USAID, 2002). Excess nitrates, phosphates and human excreta (used as fertilizer or deposited in irrigated fields) which may be transported by rainwater runoff into open water bodies where they may spread diseases such as cholera, hepatitis and worms. Irrigation activities can also create water quality problems on downstream users. The cause routes for the water quality problems are due to discharge of saline or

contaminated irrigation water. Physicochemical parameters commonly used for water quality measurement should be identified such as: pH, turbidity, suspended solids, temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved solids, salinity, conductivity. Common contaminants of concern include ammonia, arsenic, cadmium, copper, chromium, cyanide, iron, lead, manganese, mercury, molybdenum, nickel, nitrate/nitrite, sulfate, thallium, uranium, vanadium, and zinc.

#### **6.1.7. Land use and land cover**

Land uses affect the quality of water entering an irrigation area, sediment content and chemical composition from agricultural pollutants. Use of river water with large sediment load may result in canal clogging. The rural land use proclamation (Proc. No. 456/2005) stipulates rural land use and restrictions in order to ensure proper land use of various types such as slopes, gullies and wetlands, as well as utilization of rural lands for villages and social services. Therefore, collection and description of the land use land cover type of the Woreda, project implementation kebele and command area need as follows:

- Description of woreda or kebele based land use land cover from the woreda agriculture sector, land use and land administration sector, project implemented kebele office and from other sources.
- Project command area land use land covers from available data and map or observation assessment which might made during site identification.

### **6.2. Biological environment**

Biological environment are the natural features and resources of a project area. Understanding the baseline data of the biological resources help in understanding the resources that may be affected by the project, protection needs, and to enable in recommending management options in order to use sustainable uses of resources and conserve them from damage. Vegetation, wildlife, aquatic resources and others are required in baseline assessment as biological components.

#### **6.2.1. Vegetation resources**

- It needs to collect data and information of the following listed vegetation resources of the woreda and the project command area.
  - Vegetation types and their species of floristic composition (both in local and scientific names),
  - Threatened/ endangered species flora of the area (both in local and scientific name),
  - Species of plant with commercial importance (both in local and scientific name),

- Protected forest conservation areas including national priority forests
- Dominant grasses, bush trees and weeds of the area

### 6.2.2. Wildlife resources

Wildlife resources data and information of the project area is essential in an ESIA study. It needs collecting data and information of the major wildlife resources of the area. As the target of the assessment, with regard to project site, the data source can be woreda agriculture and rural development office, parks, and/or others who deal with the resources.

Accordingly, data and information can be collected as:

- Wildlife/fauna diversity of the project area,
- Threatened/ endangered species of the wildlife species,
- Species of the wild animals with commercial importance,
- Breeding and feeding areas, and mobility of existing fauna including birds,
- Species with potential to become nuisances, vectors or dangerous like malaria mosquitoes, snail hosts of bilharzias, weeds, etc.
- Common bird species, and reptiles resources of the area and
- Identify species with scientific and research significances, etc.

### 6.2.3. Aquatic resources

Assessments of aquatic life are expected in an ESIA study. Diverting water for irrigation can leave less water for downstream ecosystems that can have effects on wetlands and other aquatic lives. Discharge water from irrigated fields on the other hand may also contain more salt, less dissolved oxygen, more pollutants, and heavier silt load than the incoming flow. It also tends to be warmer than receiving rivers and streams. These changes can encourage weed growth and harm fish and bird populations of the water body intended to use for the irrigation activities. Therefore:

- Identify and collect data on major aquatic life such as fish, crocodiles and others using annexed format in the water resources intended for irrigation water use from the project area community representative and related relevant woreda offices.
- Identify and collect phytoplankton and zooplankton data in the aquatic environment,
- Wetlands (marshy and swamp areas)

### 6.3. Ecosystem service

The millennium ecosystem assessment report of 2005 defined ecosystem services as benefits people obtain from ecosystems and distinguish four categories of ecosystem services, where the so-called supporting services are regarded as the basis for the services of the other three categories.

#### Supporting services

These include services such as nutrient cycling, primary production, soil formation, habitat provision and pollination. These services make it possible for the ecosystems to continue providing services such as food supply, flood regulation, and water purification.

#### Provisioning services

The following services are also known as ecosystem goods

- Food (including seafood and game), crops, wild foods, and spices
- Raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer)
- Genetic resources (including crop improvement genes, and health care)
- Water purity
- Biogenic minerals
- Medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms)
- Energy (hydropower, biomass fuels)
- Ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)

#### Regulating services

- Carbon sequestration and climate regulation
- Predation regulates prey populations
- Waste decomposition and detoxification
- Purification of water and air
- pest and disease control
- Flood protection

#### Cultural services

- Cultural (including use of nature as motif in books, film, painting, folklore, national symbols, advertising, etc.)
- spiritual and historical (including use of nature for religious or heritage value or natural)



- recreational experiences (including ecotourism, outdoor sports, and recreation)
- science and education (including use of natural systems for school excursions, and scientific discovery)
- Therapeutic (including Eco-therapy, social forestry and animal assisted therapy)

#### 6.4. Climate pattern and climate change

Climate change (data from local people's perspectives, others), the following data are important in ESIA study:

- Water level trends
- Seasonal Water flow
- Peak runoff and volume for recurrence intervals of 1:20 and 1:50 years and regional maximum flood
- Wetland condition and coverage trends
- Crop productivity trends
- Precipitation
- Temperature trends
- Evapotranspiration (Water bodies) if available

#### 6.5. Socio-economy

All existing socio-economic situations of the project area, *kebele* or *woreda*, should be defined with proper depth before the irrigation project implementation. In most cases, there is a defined socio-economic environment that will be affected by the project. The level of information needed for the socio-economic baseline can be highly variable depending on the project size and type; which includes:

##### 6.5.1 Administrative structures

It needs identification and description on the administrative structure of the project area as indicated below.

- Indicate the project area by region, zone, *woreda* and *kebele/s*.
- Describe administering council of the *woreda* of the project area, and
- Describe responsible institution under which the environmental protection, management and monitoring is to be undertaken.

## 6.5.2 Demography

Understanding the demographic situation of the project area is very important in identifying possible cultural and religious mixes, age and sex compositions, etc. that will help to distribute resources and to adjust employment opportunities related to the project in the area. You can use the following table to collect demographic related information.

Brief description of the demographic situation of the project site, woreda or kebele should be synthesized based on data and information collected.

**Table 1: Population and project beneficiaries**

Place	HH heads			Population			Religion distribution %					Average family size	Ethnic group		Remark
	M	F	Total	M	F	Total	Orthodox	Muslim	Catholic	Protestant	Others		Group	%	
Woreda															
Kebele															
Command area															
Beneficiaries															

## 6.5.3 Livelihoods

Agriculture is the main economic bases and it is the major means of livelihoods and potential income generating sources of citizens of Ethiopia. The farming system is mixed that comprises crop and livestock productions. The potential income generating activities of the people is intensification of agricultural activities mainly cultivation of cash crops through irrigation schemes. Therefore, identify data and information of the livelihood baseline data of:

- Major livelihood bases of the communities of the project area, woreda or kebele
- Economic activities (income sources) of the local communities with clear description

## 6.5.4 Rain-fed agricultural practice

Ethiopian rural community practiced agriculture for long period of time using rain fall. The crop production is practiced during Meher and Belg seasons. For the purpose of the baseline rainfall agricultural production, relevant information on cultivated land (ha) and crop production (qt) to be collected at least for three years including:

- Major crops grown,
- Production during Meher season and
- Production during Belg season.

**Table 2** can be used to summarize information collated and with brief description. In addition, crops data, production and productivity trends with existing farming practices could be added.

**Table 2: Major crops, area & production in the project area**

Seasonal crops	E.F.Y		E.F.Y		E.F.Y		Remark
	Area (ha)	Production (quintal)	Area (ha)	Production (quintal)	Area (ha)	Production (quintal)	
Woreda Meher season major Crops							
1							
2							
3							
Woreda Belg season crops							
1							
2							
3							
Woreda-total							
Kebele Meher Season major Crops							
1							
2							
3							
Kebele Belg Season Crops							
1							
2							
3							
Kebele-total							

Source: \_\_\_\_\_ Wereda and \_\_\_\_\_ kebele, Month, year.

### 6.5.5 Irrigation agriculture

Irrigated agriculture is practiced using traditional schemes in most cases. In order to identify irrigation activities of the baseline condition of the project area, it needs to collect crops and vegetables data of few years so as to indicate trends of irrigation practices and productivity. Then data and information could be summarized using **Table 3**: List major irrigated crops grown, cultivated areas (ha) and production (qt.).

**Table 3: Major irrigation crops, cultivated area & production for the last three years**

Major Irrigated Crops	E.F.Y		E.F.Y		E.F.Y		Remark
	Area (ha)	Production (quintal)	Area (ha)	Production (quintal)	Area (ha)	Production (quintal)	
Woreda Major Irrigated Crops							
1							
2							
3							
Woreda-Total							
Kebele Major Irrigated Crops							
1							
2							
3							
Kebele-Total							

Source: \_\_\_\_\_ Wereda and \_\_\_\_\_ kebele, Month, year

### 6.5.6 Improved inputs

Information should be collected on improved seeds utilizations and its utilizing trends by the woreda and the planned project implementation area.

### 6.5.7 Crop pests and diseases

Crops pest and disease prevalence are very important for sustainability of the irrigation project. Therefore, during baseline data collection it needs to collect information on crop pests and diseases prevalence data from the woreda agriculture office and the project kebele and with brief description..

### 6.5.8 Fertilizers use

- List down organic and chemical fertilizers under use using the format in the table 6.
- Collect data of agrochemicals commonly used in the woreda.
- Collect data of some consecutive years to show the use trends.

**Table 4: Project kebele fertilizers and agrochemicals last three years use trend**

Fertilizer	_____ Year		_____ Year		_____ Year		Remark
	Quantity (Qt)	Area(ha)	Quantity (Qt)	Area (ha)	Quantity (Qt)	Area (ha)	
Woreda							
Project kebele							

Source: \_\_\_\_\_ kebele, Month, year.

### 6.5.9 Livestock

The life of our communities depends on mixed farming. The livestock sector can have positive and/or negative impact/s on the intended irrigation development. Therefore, livestock data. Should be collected using the format given in Table 5,

- Livestock population by type,
- Major livestock diseases,
- Veterinary services availability,
- Grazing areas availability and related environmental issues, etc.

**Table 5: Livestock population of project woreda and kebele**

Livestock		Woreda	Project kebele	Percent (%) distribution
Cattle	Cattle			
Equines	Horse, Mule & Donkey			
Small ruminants	Sheep			
	Goat			
Poultry	Poultry			
Beehives	Modern			
	Transitional			
	Traditional			

Source: \_\_\_\_\_ Wereda and \_\_\_\_\_ kebele, \_\_\_\_\_ Month, \_\_\_\_\_ year.

### 6.5.10 Health Service and Facility

Irrigated agriculture contributes substantially to conditions that favor good health, food security, improved infrastructure and economic growth which enables greater purchasing power for drugs and access to health services. On the other hand, irrigation development can exert significant adverse impacts on peoples living in the project area and its surroundings. Therefore, baseline information on public health and safety conditions is essential for identifying future health and safety trends of the area.

#### Health institutions

A health center is expected to service a maximum of 25,000 peoples and hospital for 100,000 peoples based on Ethiopia health coverage estimation criteria. Health institutions distribution determines health service delivery. Therefore to recommend on health services based on the , health institutions data is essential.

Therefore, collection of information on health institutions in the project area, kebele or woreda is very important using template given in Table 6.

**Table 6: Health institutions distribution**

Health Institution	Project Woreda				Project kebele			
	Private	Gov.	NGO	Total	Private	Gov.	NGO	Total
Hospital								
Health Center								
Health posts								
Clinic								
Laboratory center								
Rural drug shop								
Pharmacy								

Source: \_\_\_\_\_ Wereda and \_\_\_\_\_ kebele, \_\_\_\_\_ Month, \_\_\_\_\_ year.

## Health Professionals

Human resources or staffing of a health institution is core issues in promoting health care services. The population ratio is 1:10,000 people for a physician and 1:5,000 for nurses of all types.

Baseline information is needed on health staffs with regard to health care and services of the project area, kebele or woreda and with brief comments on health service delivery and needs.

**Table 7: Health professionals**

Types /description	Project Woreda			Project Kebele		
	Male	Female	Total	Male	Female	Total
Doctors (all categories)						
Health Officers						
Nurse (all categories)						
Sanitarians (all)						
Health extension workers						
Health Assistants						
Lab technicians (all)						
<b>Total</b>						

Source: \_\_\_\_\_ Woreda, \_\_\_\_\_ Month, \_\_\_\_\_ year.

## Diseases Prevalence

The irrigation project can exert negative impacts on peoples living in the project command area and its surroundings by aggravating some types of communicable and non-communicable diseases including HIV/AIDS, waterborne and water related diseases, etc. This information need to be included in baseline data collection at least using top ten prevalent diseases in project area, kebele or/and woreda using Table 8 template .

**Table 8: Top ten diseases of project area, kebele, or /and woreda**

No.	Diagnosis	Project Woreda				Project kebele			
		_____ Year	%	_____ Year	%	_____ Year	%	_____ Year	%
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
	Top ten total								

### 6.5.11 Education Service and Facilities

Education in the true sense is helping the individual to be mature and free, to flower greatly in love and goodness. It is the acquisition of knowledge, skills, value, beliefs and habits. The cumulative effect of education brings a nation to development and prosperity. Therefore collecting information on the availability of schools, teachers and related services in the project area is good in addressing important issues. The following table will help in collecting information from the project area.

Table Total schools, teachers and students in the project area in the last two years

School Grades	Year-----					Year-----					Remarks
	Students		Teachers		Class rooms	Students		Teachers		Class rooms	
	Male	Female	Male	Female		Male	Female	Male	Female		
1-4											
5-8											
9-10											
11-12											
Total											

### 6.5.12 Water supply Services

Access to potable water supply (Ethiopian Water Resources Management Proclamation (Proc. No. 197/2000 and the W.B /OP 4.07) is an indicator of socio-economic development index of a nation. It is not only development indicator, but also vital for the survival of human beings, prevention of diseases and improvement of the public health status of a society. Therefore, baseline information to be collected on water supply service of the project area, kebel or/ and woreda based on the Table 9.

Table 9: Project Woreda and kebele water supply sources and coverage

No.	Water supply sources	Project Woreda		Project kebele	
		Number	Coverage (%)	Number	Coverage (%)
1.					
2.					
3.					
4.					

### 6.5.13 Settlement pattern and displacement

Acquaintance of settlement pattern of community is very important in project identification and planning processes. The population density and settlement pattern has significant implications on socioeconomic impacts of an irrigation project particularly related to displacement which goes with compensations and conflicts. Therefore, as identification of the settlement patterns baseline conditions are essential for deciding possible impacts and mitigation measures including compensation. Write a paragraph or two on the settlement and possible displacements.

#### **6.5.14 Land tenure and loss / access to assets**

Land tenure can be another problem in implementation of irrigation project/s. It depends on land ownership conditions of the project beneficiaries' as communities have use rights over their land. They have the right to be benefited from fruits, crops, trees, etc. grown on the land. Land and perennial resources loss leads to conflicts unless properly compensated or the land use right of the people is kept based on existing rules and regulations. Therefore, baseline data collection should identify and collected information on:

- Land use right ownership conditions of the intended project command area.
- Perennial crops on the intended project area.
- Evaluate the ownership conditions future distribution issues.
- Identify access to resources and infrastructure.

#### **6.5.15 Infrastructure**

As availability of social, agricultural support services and public infrastructures play significant roles in successful implementation and operation of the intended irrigation project. Baseline information on conditions, of existing infrastructure are important for recommendations. Accordingly, information need to be collected on existing infrastructure in the project area, kebele or /and woreda including but not limited to:

- Agricultural support services and farmer training centers (FTC),
- Public infrastructures such as: transport and communications and other utilities.

#### **6.5.16 Historical, archaeological, cultural and religious sites**

Physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significances should be protected (with regard to Ethiopian regulations). Similarly, at community level, a number of sacred and ritual sites possess religious and cultural importance which needs protection and mitigation measures to protect by the project implementation should be included in baseline data collection. .

- Archaeological and Historical places,
- Architectural,
- Religious, sacred and ritual,
- Aesthetic,
- Palaces,
- Caves and cultural significance sites



### 6.5.17 Gender issues

In the day to day activities, women and men are exposed to adverse environmental and socio-economic impacts. In this regard, baseline information on roles and responsibilities of females and males in the communities shall be collected by using data collection format presented in Table 10, Table 11 and Table 12.

**Table 10: Gender analysis based on activities assessment**

No.	Description	Who does the work?	
		Women	Men
<b>1.</b>	<b>Reproductive Activities</b>		
	Cleaning		
	Fetching firewood / fuel		
	Fetching water		
	Preparing food		
	Childcare		
	Washing clothes and others		
<b>2.</b>	<b>Productive activities</b>		
	Land preparation		
	Cultivation and maintenance		
	Harvest/Post-harvest		
<b>3.</b>	<b>Community Support Activities</b>		
	Labour on communal projects		
	Meetings		
	Helping others in time of need		
	Other, etc.		

**Table 11: Gender analysis based on outdoor services**

No.	Resource description	Access		Control		Remark
		women	men	women	Men	
	Land					
	Fertilizer					
	seed					
	Oxen					
	Sheep/goat					
	Chicken					
	Dairy cows					
	Agricultural equipment					
	Training					
	Credit					
	Water					
	Fuel wood					
	Others, etc.					

*Source: Manual on gender analysis tools of Ethiopia, Cascape, 2015.*

**Table 12: Gender analysis based on household services**

Expense	Who is responsible?			Comment
	Men	Women	Joint (we decide together)	
Children education				
Clothing				
Health care				
Daily food items				
Inputs for the land				
Inputs for home garden				
Others, etc.				

*Source: Adopted from manual on gender analysis tools of Ethiopia, Cascape, 2015.*

#### **6.5.18 Conflicts of interests among communities and redress mechanisms available**

Most of the time conflicts exist between projects affected, benefited communities and laborers comes from other areas as a result of implementing irrigation project. Baseline data should address information on:

- Presences of project area communities conflicts,
  - Identify main causes of the local communities conflicts,
  - Identify and list existing or practiced formal and informal conflict resolution mechanisms,
- Write a paragraph based on collected data and information.

#### **6.5.19 Other existing or planned projects in the area**

Projects can have effects on each other. If irrigation projects exist on a river course, there can be conflicts due to water abstraction and downstream releases. Therefore, presence or absence of such existing or planned projects at or near the intended irrigation area should be identified to find possible solutions and solve conflicts through optimizing the project adverse impacts. Therefore, baseline information is required to be collected on:

- Existing projects in upstream, downstream or near the intended project,
- Possible impacts of the project/s on the intended water source

### **6.6. Disaster Risk**

Drought remains the country's leading major hazard while Flood is the second major hazard next to drought and recent experience shows an apparent marked increase in flood disaster in area coverage and frequency of such disasters (climate change and associated risks) 14.

The main natural disaster risks which should be addressed in the baseline study of irrigation projects includes:

- Drought (occurrences, intensities and frequencies),
- Flood (occurrences, intensities and frequencies),
- Human and livestock epidemic disease like COVID 19,
- Wildfire in the farms and surrounding forest lands,
- Earthquake (magnitude and intensity),
- Landslide (zone of potential unstable slopes and maximum size estimate),
- Volcanoes (active, dormant or extinct),
- Subsidence probability,

## 7. IMPACT ANALYSIS, ENHANCEMENT AND MITIGATION MEASURES

Under this part the ESIA addresses the irrigation project potential impacts identification, impact prediction and impact evaluation.

### 7.1. Impact identification

Impact identification includes description of the existing environmental and social system comparing with, the environment and socio-economic to be modified by the irrigation project implementation.

A number of ‘tools’ are available to assist in impact identification. The simplest, and most frequently used, are checklists of impacts, although matrices, network diagrams and map overlays are also commonly used. More complex tools, such as mathematical modelling and the use of GIS systems, may also be used in certain circumstances.

Wherever possible, the impacts should be quantified and valued in physicochemical, biological, ecosystem services, climate change, socio-economic and disaster risk at project terms presented by pre-construction, construction, operation and decommissioning phases.

Analysis of baseline information and identification of environmentally and socio-economically sensitive sites/conditions will help in the process of impact identification of irrigation projects implementation. Expansion and intensification of irrigation can have potential adverse impacts due to changes in quantity and quality of soil, changes in hydrological conditions, change in air quality and change in biological environment owing to installation and operation of irrigation schemes.

Assessing environmental and social impacts of the irrigation project generally depend on the following aspects. Therefore, the ESIA study team shall:

- Characterize the baseline – the existing conditions before the project is undertaken and any effects are generated.
- Identify sources of impacts and the impacts themselves that are generated by any aspect of the irrigation project activities.
- Rate impacts before any mitigation (for negative impacts) or enhancement (for positive impacts) is implemented;
- Suggest enhancement and mitigation measures to address the impacts identified and
- Rate impacts after mitigation to produce a “residual” impact.

The potential impacts from irrigation projects can also be a beneficial or adverse that may occur at pre-construction, construction, operation and decommissioning phase of a project as presented in

**Table 13: Likely impacts**

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
<b>Beneficial impacts</b>					
Increased incomes and income base, Food availability and Poverty reduction	√	√	√	√	Increased crop productivity and food security and break the cycle of poverty
		√	√	√	Access to irrigation allows people to not only increase their production and incomes, but also enhances their opportunities to diversify their income base, and to reduce their vulnerability to the seasonality of agricultural production and external shocks
		√	√	√	It should be noted that the poor also get chance to use water for livestock rearing, fish production, brick making and so on.
		√	√	√	Irrigation increased crop output through increasing in yield especially by making crop production possible in places where rainfall and soil moisture are insufficient throughout year-round farm.
		√	√	√	Irrigation enables smallholders to adopt more diversified cropping patterns, and to switch from low value staple production to high-value market-oriented production. Increased production makes food available and affordable for the poor by increasing purchasing power
Import substitution			√		The country is spending relatively huge amount of money for imports of various products which can be replaced by production
Promotion of export and generation of foreign exchange			√		Increases the foreign exchange by promoting export based crop production
Improving the quality and living standards of citizens			√		Irrigation can increase food availability to poor and can get sufficient crops on market
Increment in the Gross Domestic Product			√		Irrigation related surplus crop production would contribute to country GDP through crop selling inside and outside the country
Creation of eco-friendly environment			√		Development of conveniences and large scale green parks along existing streams and canals will be established which will make the place more pleasant and attractive for workers and communities

<sup>3</sup> Pre-construction phase

<sup>4</sup> Construction phase

<sup>5</sup> Operation phase

<sup>6</sup> Decommissioning phase

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
Increment in employment	√	√	√	√	Because of the labor intensive nature of irrigation huge employment opportunity created for people around and beyond the irrigation project area
Better microclimate		√	√		Creation of a better microclimate in the irrigation project area, due to development of green belt around the irrigation project area
Access infrastructures to and services	√	√	√	√	Establishment a transport link related to irrigation project which may include all weather roads and a railway that may extend into the premises of the irrigation projects giving easy access for import and export of goods for local community
		√	√	√	Development of Health Post or Clinic in any of the near the irrigation project area which can provide from low level to medium level of health services
		√			Construction of religious sites
	√	√	√		Construction of Water Supply and Sanitation
			√	√	Development of modern communication systems such as telephone lines, internet, satellite television, and short-range radio communications financed by irrigation project.
		√	√	√	The population of the irrigation project area is being served by the nearest fuel stations, postal office, a bank, court and police station services that may develop in the immediate vicinity of the irrigation project.
Other Livelihood benefits	√	√	√	√	Enhancement of skill transfer, capacity building and technology transfer
	√	√			Compensation for losses
					Access to irrigated land, for adversely affected populations and the poor
Enhancement of market and investment project area	√	√	√		Boost micro-investment in the project area
Experience sharing in Environmental management			√	√	Skill and knowledge transfer on watershed management, water quality management ,
	√	√	√	√	Protection of vegetation, habitats and specific ecosystems
		√	√	√	Water access and rights, Land uses, Natural resources management and Agricultural practices
			√	√	Sanitation and hygienic conditions
			√	√	Food supply and safe drinking water which could may devoped by the irrigation project owner
Gender	√	√	√	√	Reduce women's workload, Control over land and land proceeds, Income-generating activities, Access to facilities and services and Women's involvement in decision-making processes .Nearby availability of potable water, fire wood and other infrastructure related to the project.
Constructio n of Religion sites and Schools			√		Construction and maintenance of religious areas, cultural or historic value, and cultural monuments

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
<b>Adverse impacts</b>					
<b>Physicochemical impacts</b>					
Land use change	√	√	√	√	Existing pastoral farmers or bushes, forest changed to irrigation land and these could be linked to adverse impact on soil erosion, precipitation and hydrological impacts
Land and soil degradation			√	√	<b>Salinization:</b> Agricultural land takes nutrient leaving salt in the soil. Similarly evaporation reduces water and increasing salt in the irrigated soil. Salinity risks also increases when saline water is used for irrigation and when poor fertilizer and poor irrigation management are combined
			√	√	<b>Alkalization:</b> by an increase in the concentration of Na <sup>+</sup> + K <sup>+</sup> , HCO <sub>3</sub> <sup>-</sup> , and TDS in soil
		√	√	√	<b>Water logging:</b> It occurs when there is too much water in a plant's root zone, which decreases the oxygen available to roots. Water logging results primarily from inadequate drainage and over-irrigation and, to a lesser extent, from seepage from canals and ditches
			√	√	<b>Soil acidification:</b> Soil acidification may occur because the concentration of hydrogen ions in the soil increases, Ammonium-based fertilizers are the major contributors to soil acidification, especially if the nitrogen is leached rather than taken up by plants, Ammonium nitrogen from fertilizer or soil organic matter is readily converted to nitrate and hydrogen ions by bacteria in the soil. Removal of plant and animal products leaching ( excess nitrate leaching)
		√	√	√	<b>Loss of soil fertility:</b> All crop residue and green byproducts are removed from the field for livestock feed, fuel and house construction, as a result nutrients are removed more rapidly than they are replaced Furrow and flood irrigation along the slope leads to soil loss and nutrient depletion
Water consumption, impact on Water availability and water pollution			√		<b>Reduction in irrigation water quality:</b> irrigation which have been practiced for very different lengths of time in varying climatic and economic circumstances lead to water quality deterioration. Thus it is to be expected that the environmental impacts will also be highly variable by country and by region
			√	√	<b>Water quality problems for downstream:</b> Drainage of surface and groundwater in the irrigation project area, which waters may be salinized and polluted by agricultural chemicals like biocides and fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for crops ,industrial, municipal and household use.
		√	√		<b>Shortage of water availability especially for downstream community:</b> users caused by irrigation return flow quality-cause an increase or decrease in the availability of surface water or ground water, locally or regionally
		√	√		<b>Ground and surface water depletion:</b> an irrigation scheme draws water from groundwater, rivers, lakes or overland flow, therefore water withdrawn for irrigation has impacts on rivers , lakes and ground water reduction
			√	√	<b>Dry drinking and irrigation well:</b> some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases causing decrease in water availability in the project area
			√		<b>Reduced base flow / wetlands:</b> if it exceed the natural recharge rates of the aquifers concerned, can lower water tables and thereby reduce flows into wetlands and rivers

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
			√	√	<b>Agrochemical pollution:</b> Agrochemicals could be comes from many diffuse sources of irrigation project(s) may pollute nearby rivers, lakes, ground water and wetlands
Siltation		√	√		Especially furrow irrigation leads to silting of canals, water bodies and dams and also contributes to turbidity which affect fish and other aquatic organisms
<b>Biological impacts</b>					
Forest and bush clearance	√	√	√		Loss of habitat for animals, and conversion of biodiversity rich natural and semi natural habitats to land for crop production
			√	√	Bush encroachment resulting from selective irrigation
		√	√	√	Bush fires and other human interaction to use as irrigation land
	√	√	√		Changes to the structure and botanical composition or natural vegetation
		√	√		Loss in pasture land
		√	√		Overuse of the vegetation combined with excessive trampling leads to soil compaction and reduction in plant cover
		√	√		Degradation of rangelands due to irrigation diversification,
		√	√		Excessive use of resource if animal numbers allowed building up (ie. Not consumed locally or marketed)
Poisoning of grazing land		√	√		Poisoning of animals grazing the area where pesticides is pumped, dripped off treated livestock or deposited by spray from a spray race
Prevalence of disease causing microorganisms and insects			√		Increase in prevalence of malaria due to construction of livestock watering points
			√		Increase in tsetsefly and misquitos population in relation to establishment of irrigation dams and ponds
Fisheries, Amphibians and Reptiles			√		Aquatic and wetland species may suffer as a result of the drying out of wetlands, or lowered flow and increased temperature in rivers, as a result of abstraction for irrigation
Birds in the project area			√		Migration of birds, decline in population of birds related to habitat decline and habitat modification by irrigation induced
			√		Toxicity to birds, which ingest poisoned ticks, polluted water and other invertebrate used for bird feed
Soil Microorganisms (Fungi, Bacteria and Actinomycete)			√		Various chemicals and nutrients used have adverse impacts on soil and aquatic microorganism and on their interaction
<b>Impacts Ecosystem services not limited to:</b>					
		√	√		Reduced bio-diversity due to forest clearance ,water pollution, soil pollution or /and air pollution
		√	√		Migration and productivity of fish species Reduced bio-diversity due to forest clearance ,water pollution, soil pollution or /and air pollution
		√	√		Changes in primary productivity due to biochemical reactions, algal blooms and high in secondary productivity(zooplankton)



Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
Biodiversity loss and risks		√	√		Risk of eutrophication / growth of non-native and/or invasive species
		√	√		Opportunistic growth of aquatic macrophytes in the littoral and sub-littoral zone of the aquatic environment in relation to sedimentation and other nutrients enrichment from irrigation
		√	√		Creation of favorable habitats for the growth and proliferation of disease vectors(water availability, change in local temperature, etc.)
		√	√		Irrigation can also bring new risks beyond the farm scale, for example as related to crop disease and diversity as demand for traditional crops or seed varieties decline
		√	√		Damage to downstream ecosystems due to reduced water quantity, quality and sedimentation
Ecological function			√	√	Adverse impacts on ecological function such as carbon storage, nutrient cycling, water air purification, diseases regulation, Soil formation, primary production and pollination
Ecosystem services  - Habitat service loss - Impact on economic Service/supporting service - Impacts on social Service/cultural services - etc		√	√		Silting of water bodies and dams contributes to sediment loads and turbidity which affect fishery and other aquatic ecosystem services.
		√	√		Existing water resources functions and services (cleaning, drinking, etc) declining and loss
		√	√		Existing vegetation resource's functions and services (medicinal, energy, etc) is declining or loss
		√	√		Existing land resource's functions and services (grazing land, communal land, forest land, etc) is declining or loss
		√	√		Habitats/ecosystems reserved for special interest such as conservation, scientific importance, recreational value, etc.,
		√	√		Habitats designated for wildlife conservation such as National Parks, Wildlife Sanctuaries, Wildlife Reserves and Controlled Hunting Areas
		√	√		(Loss of home for various wildlife, fish, amphibians and microorganisms
		√	√		Loss of provision such as fresh water, genetic resources, timber, food, fuel and bio-products
		√	√		Loss in social and cultural benefits such as recreation, traditional resource uses and spirituality, education service, aesthetic value
<b>Disaster Risks not limited to:</b>					
Flooding, disease, pests and disease infestations, land slide, etc		√	√	√	Failure of irrigation dam, canals and other irrigation infrastructures may result in flood occurrences
			√	√	Human and livestock disease epidemics
			√		Crop pests,
		√	√		Earthquake related to irrigation dam
		√	√	√	Land slide,
<b>Contribution to Weather and Climate change</b>					
Change in atmospheric circulation			√	√	Irrigation has immediate effects on the provision of moisture to the atmosphere, inducing atmospheric instabilities and increasing downwind rainfall, or in other cases modifies the atmospheric circulation, delivering rain to different downwind areas.
				√	Irrigation induced Precipitation and temperature change
			√		Evaporation will increase due to irrigation activities and causes more water vapor (GHG)

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
Green house gaseous (GHG) emission		√	√		Land use change due to irrigation is responsible for global greenhouse gas emissions, principally from deforestation which more related to greater temperature variations, decreased proportions of soil retention of carbon, and changes in precipitation Repetitive ploughing causes change in soil physicochemical properties that finally lead to more soil microbial respiration which releases GHG.
			√		Water logging due to improper drainage of excess water will cause production of GHG (Methane) due to soil oxygen deficiency (anoxia)
<b>Impacts on Socio-economy</b>					
Change in population size	√	√	√		As irrigated agriculture demands much labour, influxes of migrant laborers were attracted from the surrounding area and boosted the laborers population size of the irrigation area
Economy	√	√	√	√	Shift in way of life –from pastorals to farming practice – this may challenge the economy of the area especial at initial stage the project practice due to lack of experience
Women and men work load, absence from education and sexual harassment		√	√	√	Irrigation intentionally hires women for work which poses work load on them. Manual operated irrigation prefer men for work.This pose selective work onment
	√	√	√		Absence from school due to engagement of selective women or men(both) on the irrigation project
					Women and men may be exposed to sexual harassment especially when they are far from the home and parents
Displacement	√	√			Displacement of population from their land and home when their lands taken for irrigation purpose
Land Acquisition and Loss of livelihood	√	√			The most adverse socioeconomic impacts of the irrigation project are the dispossession of farmland and displacement of farmers from their agricultural land and residences.
	√	√			Impacts on Housing Structures and Homesteads ( especially caused by involuntary resettlement)
Disruption of Social and Cultural Ties	√	√	√		A sense that they feel some discomfort and fear of the disruption of their social and cultural ties due to displacement.
Impacts on Public, health, Community Institutions and infrastructures	√	√			Impact on social services and facilities like public buildings, schools, health facilities, water supply and religious institutions (churches and mosques destruction of existing roads a railway and other social service when found at the at premises of the irrigation projects
Social evils	√	√	√		Increased financial flow, social evils (drug abuse, unwanted pregnancies and violence), boom and bust phenomenon associated with temporary labor influxes
Increased level of disease vectors	√	√	√		Wastes disposed haphazardly form micro-environments for breeding of disease vectors. The crevices could provide habitats for mosquitoes, rats, cockroaches, flies.
Public health		√	√		Increased incidence of water-related disease such as diarrhea, malaria or sleeping sickness
		√	√		Risk of introduction of new diseases as schistosomiasis
		√	√		Communicable diseases Construction activities: in irrigation projects may pose labor to the project site which may bring communicable diseases (HIV/AIDS, COVID-19, etc)

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
<b>Occupational health and safety</b>		√	√		<b>Chemical Exposures/Poisonings</b> —result in acute and/or long-term health hazards for personnel who handle chemicals, pollution or other products, or reduce such risks. Workers result in an increased or decreased risk that chemicals are unintentionally spread, by air, water or via food chains, through the use of chemicals, or through poor storage conditions or inadequate facilities for the destruction of waste products
		√	√		<b>Dust and other particulate matter</b> - land preparation cause dust re-suspension and vehicles and machineries release dust and particulate matter that health effect on lung function
		√	√		<b>Machinery and working equipments</b> -mobile machines such as tractors, front-end loaders, skid-steers, material handlers and forklifts are often used inside and outside agricultural installations for production, daily chores or intermittent maintenance activities. Machines used in agricultural installations may also use buckets, forks or blades for handling manure, feed or other materials. Hazards for these activities may include being crushed by falling objects or materials from buckets and lifts, run-over of co-workers or bystanders, machines slipping off the edges of ramps or building drop-offs
		√	√	√	<b>Electrical Contacts and Fire explosion</b> Workers contact with Overhead power line , short circuits, when working on energized equipment, lightning strikes.Fire explosion related to improper electric evacuation
		√	√		<b>Contact/Entanglement with Moving Parts</b> -due to the mechanical nature of lifting, pressurizing and transporting water, irrigation pumping plants universally consist of rotating parts. Common rotating components include belt drives, drive shafts, fan blades, pump vanes, right-angle drives, motors, etc.
		√	√		<b>Falls from height</b> - workers fall from ladder and when working at a height during equipment installation, product transportation and storage
		√	√		<b>Drowning</b> –to rivers, lakes, canals, ponds, pits used for irrigation purpose , etc.
		√	√		<b>Physical Damage (Head, Eye, Ear, Hand &amp; Foot)</b>
		√	√		<b>Ergonomics and heading of materials:</b> ergonomic factors affect the health outcomes of irrigation workers includes:– the nature of the physical work environment (noise, heat, lighting, thermal comfort), the agricultural tasks to be performed;– the technology applied to the prescribed tasks (including workplace design, facility design, and agricultural material handling);– the manner in which tasks are organized (including use of shift work); and – worker characteristics (including demographics, physiology, human error, and identification and treatment of injured workers).
		√	√		<b>Vibration</b> - vibration of agricultural machinery and vehicles
			√		<b>Waste</b> - workers exposed to both liquid and solid wastes resulted from irrigation input and out put
			√	√	<b>Injury from wild animals</b> –Insects, snakes bites when irrigation implemented at remote area
		√	√		<b>Noise exposure</b> – machines and vehicles produce noise that can affect the hearing of the workers and permanent damage to ears
		√	√		<b>Confined space</b> -entry into confined spaces can pose very serious risks for workers, including suffocation and drowning(during ground water abstraction, product storage and electric installation)

Expected impact	PCP ( <sup>3</sup> )	CP ( <sup>4</sup> )	OP ( <sup>5</sup> )	DP ( <sup>6</sup> )	Detail of impacts
	√	√	√		<b>Traffic accident, fall collision during transportation of material and agricultural product-</b> agricultural workers use a variety of vehicles for transportation, including buses, trucks, trailers, automobiles, all-terrain vehicles, bicycles and agricultural equipment. Operators and passengers can fall while mounting or dismounting. They can fall within or from vehicles during transport. They can be injured by contact with interior paneling or fixtures, other persons, or objects during unexpected stops and starts or in a turnover or collision. Often oxen, donkeys, mules, etc., are often used as a means of transport of people, equipment and goods. There is health risks and chance of getting physical injury in this case
		√	√		<b>Exposure to bad weather /climate</b> – irrigation is mostly practiced at outdoor at very hot and cold climate conditions. This could may cause heat induced health risk such as comma, brathing difficult, loss of excess salt
Loss of jobs				√	After decommission of the project /phase out of the project the employers might loss their job
Life cycle impact	√	√	√	√	The product life cycle impact on the environment (packing material nature; specially lack of biodegradability)
<b>Complaints/grievance s and Conflicts</b>	√	√	√		Grievances resulting from incompatibility workers culture and customs to the local culture or competition over employment with local community, or conflict related to loss of control / income of land, new flooding occurrence from irrigation project
					Labour issues are always a source of friction between companies and communities and also among community members.
	√	√	√		When problem/conflict is not solved timely and the risk level on the project may dramatically increase
	√	√	√		Communities/stakeholders and project affected person may turn to protest and conflict which needs good grievances redness mechanisms resolution

## 7.2. Impact prediction

The objective of prediction is to estimate the magnitude, extent and duration of the impact/s in comparison with the situation without irrigation project/baseline information. An environmental and social impacts prediction should, at minimum, perform the following tasks:

- Determine the initial reference or baseline state (i.e. conditions/levels prior to project);
- Forecast the future state/conditions with and without the project; and,
- Compare the impacts/condition with environmental and socio-economic standards and guidelines where appropriate.

There are many potential methods to predict impacts.. One of the most obvious, useful and effective means of prediction is simply by drawing upon expert knowledge, judgment, deduction, intuition, either individual; using a panel ; using numerical analysis and modeling, using established empirical, statistical; experimental based models that have the necessary reliability and credibility; using analogies and comparisons with similar recorded effects, including extra-polations and using overlays and sieve mapping, combining graphic and numerical data in the GIS . . Prediction methods vary considerably for each irrigation type/ scale, but generally may include either of the following and it can be done using information given in Table 14 :

**Table 14: Impact prediction**

Quantitative Rates	Extent of impacts	Intensity (severity) of impacts (I)	Duration of impacts (D)
1	Kebele Level	No effect at all	Very short time (< 1 year)
2	Woreda Level	The impact affects the environment in such a way that natural, cultural and/or social functions and processes are affected at lower amount	Short-term (1 – 5years)
3	Zone level	The affected environment is altered but the natural, cultural and/or social functions and processes are continue albeit in a modified way	Medium-term (5– 15years)
4	Country level	Natural, cultural and/or social functions and processes are altered to the extent that it will	Long-term (> 15 years but temporarily ceases)
5	International level	Natural, cultural and/or social functions and processes are altered to the extent that it will	Permanent (> 15 years but permanently ceases)

## 7.3. Impact evaluation

Evaluation of impacts significance is determination of the incidence or magnitude and significance level of the impact/s with absence of mitigation. It is done against a framework of criteria and measures established for the purpose. Specific criteria are such as , environmental standards and thresholds, protected and sensitive areas, valued ecological functions and components, and resource

and land capabilities, etc. in evaluating environmental and social impacts, checklists and other approaches can be used as shown in Table 15.

**Table 15: Impact consequence evaluation**

Impact consequence	Classification
Impact consequence (E + I + D) less than or equal to 3	Very low
Impact consequence (E + I + D) greater than 3 and less than or equal to 5	Low
Impact consequence (E + I + D) equal to 6	Medium
Impact consequence (E + I + D) equal to 7	High
Impact consequence (E + I + D) equal to and greater than 8	Very high

Following the impact consequence determination, impact significance can be evaluated using probability of occurrence of impacts using professional judgment and hence impact significance can be rated as shown in Table 16.

Once the consequence is derived, the probability of the impact occurring will be considered, using the probability classifications. The probability or degree of certainty of the impact is then rated low and high depending the degree of likeliness of the impact happening regardless of prevention measures.

The overall significance of impacts is determined as a function of the consequence and probability of the impact using the rating system described in the following formula and Table 16:

Impact significance = Consequence of impact \* Probability of impact

Based on the above calculation, the negative impacts from the implementation of the irrigation project will be explained in Table 16.

**Table 16: Impact significance calculation**

		Probability of Impacts		
		Unlikely	Possibly	Definitely
Consequence of Impacts	Very low	Very low	Very low	Very Low
	Low	Low	Low	Low
	Medium	Low	Medium	Medium
	High	Medium	High	High
	Very high	Medium	Very high	Very high
	.....Impact Significance.....			

Based on the scale and type of irrigation the impact significance may be different which can be evaluated based on expert judgment and other relevant methods using Table 21 of annex IV. After

evaluation the significant, moderately significant and highly significant impacts will be considered for enhancement and mitigation planning of impacts which reduces the volume of impacts by illuminating the non-significant impacts.

#### **7.4. Enhancement and Mitigation Measures**

Enhancement of beneficial impacts and mitigation of adverse impacts are amenable to different approaches, but in general, the following preferred hierarchies of enhancement and mitigation measures are shown in Table 17.

**Table 17: Impacts Enhancement and mitigation measures**

Expected impact	PCP ( <sup>7</sup> )	CP ( <sup>8</sup> )	OP ( <sup>9</sup> )	DP ( <sup>10</sup> )	Detail of impacts	
Beneficial impacts						Enhancement measures
Increased incomes and income base, Food availability and Poverty reduction	√	√	√	√	Increased crop productivity and food security and break the cycle of poverty	<ul style="list-style-type: none"> <li>• Give preference to local employment (men and women) and local inputs (food, basic material) to the extent possible.</li> <li>• Ensure that revenues generated by crop production activities are sufficient to cover the cost of irrigation infrastructures construction and maintenance.</li> <li>• Base profitability projections on conservative revenue assumptions.</li> <li>• Whenever possible, give priority access to irrigated schemes to men and women who are losing productive means (owners and people cultivating the land).</li> <li>• Ensure that compensations cover all revenue and asset losses by adversely affected men and women, either if they are landowners or land users.</li> <li>• Identify why specific groups are not benefiting from the project and adopt corrective measures as required, such as favouring excluded groups when irrigated schemes are reallocated or expanded.</li> <li>• Ensure that women are directly paid for their work, avoiding intermediaries.</li> <li>• Ensure that not only land owners but also women and men occupying / cultivating the land are compensated for the losses related to the project.</li> <li>• Ensure that project promoters do not reinforce cultural barriers affecting negatively women</li> <li>• Consider targeting women beneficiaries when inequities exist</li> </ul>
		√	√	√	Access to irrigation allows people to not only increase their production and incomes, but also enhances their opportunities to diversify their income base, and to reduce their	<ul style="list-style-type: none"> <li>• Training on diversified income bases</li> </ul>

<sup>7</sup> Pre-construction phase

<sup>8</sup> Construction phase

<sup>9</sup> Operation phase

<sup>10</sup> Decommissioning phase



Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
					vulnerability to the seasonality of agricultural production and external shocks	
		√	√	√	It should be noted that the poor also use water for other farm and non-farm production activities, particularly small-scale rural enterprises such as livestock rearing, fish production, brick making and so on.	<ul style="list-style-type: none"> <li>• Training on diversified income bases and enhance extension services of the farmers</li> </ul>
		√	√	√	Irrigation increased crop output through increases in yield especially by making crop production possible in places where rainfall and soil moisture are insufficient throughout year-round farm.	<ul style="list-style-type: none"> <li>• Awareness of water conservation, use improved seed varieties, provision of early maturing seed varieties</li> </ul>
		√	√	√	Irrigation enables smallholders to adopt more diversified cropping patterns, and to switch from low value staple production to high-value market-oriented production. Increased production makes food available and affordable for the poor by increasing purchasing power	<ul style="list-style-type: none"> <li>• Awareness of creation and incentive provision in market oriented production systems</li> </ul>
Import substitution			√		The country is spending relatively huge amount of money for imports of various products which can be replaced by production	<ul style="list-style-type: none"> <li>• Awareness creation, incentive provision, market linkage, media coverage for use of locally produced irrigation products as a substitute for imported products</li> </ul>
Promotion of export and generation of foreign exchange			√		Increases the foreign exchange by promoting export based production	<ul style="list-style-type: none"> <li>• Awareness of creation and incentive provision export production systems</li> <li>• Foreign market linkage creation</li> <li>• Easy logistic services</li> </ul>
Improve quality of life			√		Improving the quality and living standards of local beneficiaries and the general population	<ul style="list-style-type: none"> <li>• Increase irrigation sustainability by reducing postharvest losses, providing irrigation and postharvest technologies, etc</li> </ul>
GDP			√		Increment in the Gross Domestic Product	<ul style="list-style-type: none"> <li>• Increase productivity by applying proper and sustainable technology</li> <li>• Decrease unemployment rate</li> <li>• Awareness in tax paying and tax collection system</li> <li>• Ease taxpaying system from different sources</li> </ul>
Creation of eco-friendly environment and better microclimate			√		<p>Development of conveniences and large scale green parks along existing streams and canals will be established which will make the place more pleasant and attractive for workers and communities</p> <p>Creation of a better microclimate in the irrigation project area, due to development of green belt around the irrigation project area</p>	<ul style="list-style-type: none"> <li>• Awareness creation in greening programs and waste management system</li> <li>• Provide place for Nursery establishment</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
Increment in employment	√	√	√	√	Because of the labor intensive nature of irrigation huge employment opportunity created for people around and beyond the irrigation project area	<ul style="list-style-type: none"> <li>Give preference to local employment (men and women) and local inputs (food, basic material) to the extent possible.</li> </ul>
Access to infrastructures and services					Establishment a transport link related to irrigation project which may include all weather roads and a railway that may extend into the premises of the irrigation projects giving easy access for import and export of goods for local community Development of Health Post or Clinic in any of the near the irrigation project area which can provide from low level to medium level of health services Construction of religious sites Construction of Water Supply and Sanitation Development of modern communication systems such as telephone lines, internet, satellite television, and short-range radio communications irrigation to the irrigation project. The population of the irrigation project area is being served by the nearest fuel stations, postal office, a bank, court and police station services that may develop in the immediate vicinity of the irrigation project.	<ul style="list-style-type: none"> <li>During project preparation, consulting concerned ministries to verify the adequacy of current and proposed social infrastructures.</li> <li>Involve users, men and women, in the maintenance and management of new infrastructures to ensure their sustainability.</li> <li>Ensure appropriate social services are available to address the basic needs of the host and migrant populations.</li> <li>Assist social service administrations in coordinating their efforts to offer additional services and improve service delivery, if required.</li> <li>Implement consumption fees on irrigation water to finance infrastructure construction and maintenance.</li> <li>Promote safety net measures to protect the poor and other vulnerable groups against price increases in social services.</li> <li>Awareness to the investor for its corporate social responsibility</li> </ul>
Skill transfer, capacity building and technology transfer	√	√	√	√	Capacity building skill and technology transfer in irrigation	<ul style="list-style-type: none"> <li>Enhancement of, capacity building, skill transfer and technology transfer through provision of practical training and demonstration</li> <li>Development of farmers training center</li> <li>Prepare farmers field day</li> </ul>
Enhancement of market and investment project area	√	√	√		Boost micro-investment in the project area	<ul style="list-style-type: none"> <li>Training on better service provision</li> <li>Information provision for consumers of irrigation products</li> </ul>
Experience sharing in Environmental management			√	√	Watershed management, increase water quality and use	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>
	√	√	√	√	Protection of vegetation, habitats and specific ecosystems	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>
		√	√	√	Water access and rights, Land uses, Natural resources management and Agricultural practices	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>
			√	√	Sanitation and hygienic conditions	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
			√	√	Food supply and safe drinking water	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>
Gender	√	√	√	√	women's workload, unable to control over land and land proceeds, lack of participation in Income-generating activities, Lack of access to facilities and services and Women's involvement in decision-making processes	<ul style="list-style-type: none"> <li>Promote women and children with means to reduce the workloads on them</li> <li>Plan for the expansion of service points to the nearby human settlements while planning an irrigation project.</li> <li>Plan and support initiatives to capacitate women's involvement on decision makings.</li> </ul>
<b>Adverse impacts</b>					<b>Detail impacts</b>	<b>Mitigation measures</b>
<b>Physicochemical impacts</b>						
Land use change	√	√			Existing pastoral farmers or bushes, forest changed to irrigation land and these could be linked to adverse impact on soil erosion, precipitation and hydrological impacts	<ul style="list-style-type: none"> <li>Increase awareness of the community for the erosion free grazing, avoid unwanted deforestation, rehabilitation and afforestation of degraded communal lands, area closure, etc.</li> </ul>
Land and soil degradation			√	√	<b>Soil compaction and salinization:</b> Agricultural land takes nutrient leaving salt in the soil. Similarly evaporation reduces water and increasing salt in the irrigated soil. Salinity risks also increases when saline water is used for irrigation and when poor fertilizer and poor irrigation management are combined	<ul style="list-style-type: none"> <li>Irrigation technology improvement (Like Drip)</li> <li>Leaching the salts</li> <li>Minimize use of inorganic fertilizer</li> <li>Avoid use of salty water</li> <li>Minimize the use of heavy machinery and limit their circulation to minimal areas.</li> <li>At the end of construction works, level off the soils and facilitate vegetation regeneration.</li> <li>Use existing borrow pits rather than creating new ones; after the works, restore borrow pits by stabilizing slopes and facilitating vegetation regeneration.</li> <li>Avoid to clear vegetation along water bodies.</li> <li>Minimize and clearly define the land clearing areas.</li> <li>Avoid steep slope and level the land (terrace on slopes) as much as possible.</li> <li>Maintain vegetation hedges in order to reduce wind erosion.</li> </ul>
			√	√	<b>Alkalization:</b> by an increase in the concentration of Na <sup>+</sup> + K <sup>+</sup> , HCO <sub>3</sub> <sup>-</sup> , and TDS in soil	<ul style="list-style-type: none"> <li>Irrigation technology improvement (Like drip irrigation)</li> <li>Leaching the salts</li> <li>Minimize use of inorganic fertilizer, instead using compost</li> <li>Avoid use of salty water where possible</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
		√	√	√	<b>Water logging:</b> It occurs when there is too much water in a plant's root zone, which decreases the oxygen available to roots. Water logging results primarily from inadequate drainage and over-irrigation and, to a lesser extent, from seepage from canals and ditches	<ul style="list-style-type: none"> <li>In order to avoid water saturation, regulate adequately the irrigation (avoid excessive irrigation), maintain the drainage network and select an irrigation system that is low demanding in water and appropriate for crops.</li> </ul>
			√	√	<b>Soil acidification:</b> Soil acidification occurs because the concentration of hydrogen ions in the soil increases, Ammonium-based fertilizers are the major contributors to soil acidification, especially if the nitrogen is leached rather than taken up by plants, Ammonium nitrogen from fertilizer or soil organic matter is readily converted to nitrate and hydrogen ions by bacteria in the soil. Removal of plant and animal products leaching of excess nitrate	<ul style="list-style-type: none"> <li>Irrigation technology improvement (Use of drip irrigation)</li> <li>Leaching the salts using clean water</li> <li>Minimize use of inorganic fertilizer ,instead using compost</li> <li>Use of lime treatment and bio char to minimize soil acidification</li> </ul>
		√	√	√	<b>Loss of soil fertility:</b> All crop residue and green byproducts are removed from the field for livestock feed, fuel and house construction, Nutrients are removed more rapidly than they are replaced Furrow & flood irrigation along the slope leads to soil loss and nutrient depletion	<ul style="list-style-type: none"> <li>Use residues of the crop for self-mulching</li> <li>Use compost</li> <li>Use improved irrigation methods (like drip irrigation)</li> <li>Reduce unnecessary frequency of irrigation</li> <li>Use of SWC structural measures</li> <li>Prepare proper drainage sytem</li> </ul>
Water consumption, impact on Water availability and Water pollution			√	√	<b>Water quality problems for downstream:</b> Drainage of surface and groundwater in the irrigation project area, which waters may be salinized and polluted by agricultural chemicals like biocides and fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for industrial, municipal and household use, Use of waste water for irrigation	<ul style="list-style-type: none"> <li>Maintain vehicles, machinery and equipment in good condition in order to avoid leaks and spill of hazardous materials.</li> <li>Take all precautions during the refueling of vehicles, machinery and pumps, and forbid the refueling near water bodies.</li> <li>Ensure a safe management of hazardous materials.</li> <li>Avoid crossing permanent waterways; if necessary, locate the crossing where the banks are stable and the narrowest.</li> <li>Do not hamper drainage of surface water and plan for restoration measures after construction.</li> <li>Plan works in areas prone to flooding outside the rainy season.</li> <li>Install appropriate sanitary facilities in workers' camps.</li> <li>Adopt a watershed management approach while designing the project.</li> <li>Minimize the loss of water caused by leaks, evaporation and infiltration through canals and reservoirs (e.g. maintain vegetation along water canals).</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
						<ul style="list-style-type: none"> <li>Develop compensation measures for affected downstream water users.</li> <li>Ensure that drainage water complies with discharge standards, treat wastewater accordingly and ensure safe re-use of wastewater.</li> <li>Design water canals for reducing sedimentation and facilitating drainage and maintenance.</li> <li>Control access to irrigation water for other purposes than irrigation (safety measures and rules).</li> <li>Remove aquatic vegetation from margins of water canals and reservoirs.</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>
		√	√		<b>Shortage of water availability especially for downstream community:</b> users caused by irrigation return flow quality-cause an increase or decrease in the availability of surface water or ground water, locally or regionally	<ul style="list-style-type: none"> <li>Alternative water sources provision for downstream users</li> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>
		√	√		<b>Ground and surface water depletion:</b> An irrigation scheme draws water from groundwater, rivers, lakes or overland flow, there for withdrawn for irrigation has impacts on rivers , lakes and ground water reduction	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Practice good watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>
			√	√	<b>Dry drinking &amp; irrigation well:</b> Some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>
			√		<b>Reduced base flow / wetlands:</b> If they exceed the natural recharge rates of the aquifers concerned, can lower water tables and thereby reduce flows into wetlands and rivers	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>
			√	√	<b>Agrochemical pollution:</b> Nonpoint source pollution, unlike pollution from point sources such as industrial and sewage	<ul style="list-style-type: none"> <li>Avoid use of excessive industrial fertilizer</li> <li>Minimize use of pesticide and herbicides</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
					treatment plants, comes from many diffuse sources of irrigation project(s), etc	<ul style="list-style-type: none"> <li>• Use bioremediation</li> </ul>
Siltation		√	√		Silting of canals, water bodies and dams contributes to sediment loads and turbidity which affect fish and other aquatic organisms	<ul style="list-style-type: none"> <li>• Practice good watershed management</li> <li>• Fitting of screens at the inlet from diversions to canals</li> <li>• Delineate buffer zone for water bodies</li> </ul>
<b>Biological impacts</b>						
Forest and bush clearance	√	√	√		Loss of habitat for animals, and conversion of biodiversity rich natural and semi natural habitats to crop production (to irrigation project)	<ul style="list-style-type: none"> <li>• Delineate buffer zone in irrigation side which serve wild life and animals</li> </ul>
			√	√	Bush encroachment and bush fires resulting from selective grazing	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Area closure for forest and bush regeneration and rehabilitation</li> </ul>
	√	√	√		Changes to the structure and botanical composition or natural vegetation which are not necessarily negative	<ul style="list-style-type: none"> <li>• Afforestation of diversified forest varieties</li> <li>• Manage sensitive and endangered species</li> <li>• In situ or ex situ conservation</li> <li>• Reduce cutting of indigenous trees</li> <li>• Apply agroforestry</li> </ul>
		√	√		Loss in pasture land	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Area closure</li> </ul>
		√	√		Overuse of the vegetation combined with excessive trampling leads to soil compaction and reduction in plant cover	
		√	√		Degradation of rangelands due to livestock diversification,	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Area closure</li> <li>• Forage plantation</li> </ul>
		√	√		Excessive use of resource if animal numbers allowed building up (ie. Not consumed locally or marketed)	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Forage plantation</li> </ul>
Poisoning of grazing land		√	√		Poisoning of animals grazing the area where pesticides is pumped, dripped off treated livestock or deposited by spray from a spray race	<ul style="list-style-type: none"> <li>• Avoid spilling of agrochemicals in grazing land</li> <li>• Good management of machinery oils and greases</li> </ul>
Prevalence of disease causing microorganisms and insects			√		Increase in prevalence of malaria due to construction of livestock watering points	<ul style="list-style-type: none"> <li>• Clean and avoid insect breeding sites</li> <li>• Spray chemicals</li> </ul>
			√		Increase in tsetsefly population	<ul style="list-style-type: none"> <li>• Clean and avoid insect breeding sites</li> <li>• Spray chemicals</li> </ul>
Fisheries, Amphibians and Reptiles			√		Aquatic and wetland species may suffer as a result of the drying out of wetlands, or lowered flow and increased temperature in rivers, as a result of abstraction for irrigation	<ul style="list-style-type: none"> <li>• Use of alternative water resources</li> <li>• Establishment of buffer zone</li> <li>• Good management of agro-chemicals</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
Birds in the project area			√		Migration of birds, decline in population of birds related to habitat decline and habitat modification	<ul style="list-style-type: none"> <li>Minimize unnecessary bird site destruction</li> <li>Avoid unnecessary chemical release</li> </ul>
					Toxicity to birds, which ingest poisoned ticks	
Soil Microorganisms (Fungi, Bacteria and Actinomycete)			√		Various chemicals and nutrients used have adverse impacts on soil and aquatic microorganism and on their interaction	<ul style="list-style-type: none"> <li>Avoid use of heavy machinery operations</li> <li>Use of organic fertilizers</li> <li>Avoid use of unnecessary chemicals</li> <li>Use of soil reclaiming seed varieties</li> <li>Reduce erosion</li> </ul>
<b>Impacts on Ecological, Ecosystem function and services not limited to:</b>						
Biodiversity loss and risks		√	√		Reduced bio-diversity	<ul style="list-style-type: none"> <li>Afforestation of diversified forest varieties</li> <li>Manage sensitive and endangered species</li> <li>In situ or ex situ conservation</li> <li>Reduce cutting of indigenous trees</li> <li>Apply agroforestry</li> </ul>
		√	√		Migration and decrease in fish productivity	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation of water bodies</li> </ul>
		√	√		Changes in primary productivity due to biochemical reactions	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation of water bodies</li> </ul>
		√	√		Risk of eutrophication / growth of non-native and/or invasive species	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation of water bodies</li> </ul>
		√	√		Opportunistic growth of aquatic macrophytes in the littoral and sub-littoral zone of the aquatic environment	<ul style="list-style-type: none"> <li>Reduce siltation of water bodies</li> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Avoid unnecessary excess water abstraction and use alternative water sources</li> <li>Good weed management</li> </ul>
		√	√		Irrigation can also bring new risks beyond the farm scale, for example as related to crop disease and diversity as demand for	<ul style="list-style-type: none"> <li>Conservation of traditional varieties</li> <li>Use of scientifically approved and locally adaptable seed variety</li> </ul>



Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
					traditional varieties decline	<ul style="list-style-type: none"> <li>On time spray and weeding</li> </ul>
Ecological function			√	√	Adverse impacts on ecological function such as carbon storage, nutrient cycling, water air purification, diseases regulation, Soil formation, primary production and pollination	<ul style="list-style-type: none"> <li>Increasing carbon sequestration capacity through organic fertilizer application</li> <li>Avoid repetitive ploughing if possible</li> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Avoid unnecessary excess water abstraction</li> <li>Good weed management</li> </ul>
Ecosystem services  - Habitat service loss - Impact on economic Service/supporting service - Impacts on social Service/cultural services - etc		√	√		Silting of water bodies and dams contributes to sediment loads and turbidity which affect fishery and other aquatic ecosystem services.	<ul style="list-style-type: none"> <li>Reduce siltation of water body , establish buffer zone</li> </ul>
		√	√		Decrease existing water resource's functions and services (cleaning, drinking, etc)	<ul style="list-style-type: none"> <li>Reduce water pollution through good chemical management and watershed management</li> </ul>
		√	√		Decrease existing water resources functions and services (cleaning, drinking, etc)	<ul style="list-style-type: none"> <li>In situ and ex situ conservation for indigenous medicinal plants</li> </ul>
		√	√		Existing land resource's functions and services (grazing land, communal land, forest land, etc)	<ul style="list-style-type: none"> <li>Prepare land use plan for optimized use of resources</li> </ul>
		√	√		Habitats/ecosystems reserved for special interest such as conservation, scientific importance, recreational value, etc., declined	<ul style="list-style-type: none"> <li>Preparation of alternative recreational botanical garden</li> </ul>
		√	√		Habitats designated for wildlife conservation such as National Parks, Wildlife Sanctuaries, Wildlife Reserves and Controlled Hunting Areas Lost /Declined	<ul style="list-style-type: none"> <li>Change the layout of canal systems</li> <li>Diversion site change</li> </ul>
		√	√		Loss of provision such as fresh water, genetic resources, timber, food, fuel and bio-products	<ul style="list-style-type: none"> <li>Nursery establishment</li> <li>Ex situ gene bank conservation</li> <li>Reforestation</li> </ul>
<b>Disaster Risks not limited to:</b>					.	
Flooding, disease, pests and disease infestations, land slide, etc		√	√	√	Failure of irrigation dam, canals and other irrigation infrastructures may result in flood occurrences	<ul style="list-style-type: none"> <li>Proper stability checking of dam and periodical monitoring of dam status</li> </ul>
			√	√	Human and livestock disease epidemics	<ul style="list-style-type: none"> <li>Avoid insect breeding sites</li> <li>Avoid water ponding</li> <li>Vaccination of animals and humans</li> </ul>
			√		Crop pests,	<ul style="list-style-type: none"> <li>Use of pesticides</li> <li>Use of improved pest resistant varieties</li> </ul>



Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
		√	√		Earthquake related to irrigation dam	<ul style="list-style-type: none"> <li>• Use light weight construction materials</li> </ul>
		√	√	√	Land slide,	<ul style="list-style-type: none"> <li>• Avoid irrigation related gully and rill erosions</li> <li>• Avoid formation of gorges</li> </ul>
<b>Contribution to Weather and Climate change</b>						
Change in atmospheric circulation			√	√	Irrigation has immediate effects on the provision of moisture to the atmosphere, inducing atmospheric instabilities and increasing downwind rainfall, or in other cases modifies the atmospheric circulation, delivering rain to different downwind areas.	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>
				√	Precipitation and Temperature change	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>
			√		Evaporation will increase due to irrigation activities and causes more water vapor (GHG)	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>
Green house gaseous (GHG) emission		√	√		Land Use Change due to irrigation is responsible for global greenhouse gas emissions, principally from deforestation which more related to greater temperature variations, decreased proportions of soil retention of carbon, and changes in precipitation Repetitive ploughing causes change in soil physicochemical properties that finally lead to more soil microbial respiration which releases GHG.	<ul style="list-style-type: none"> <li>• Practice agroforestry</li> <li>• Reduce repetitive ploughing</li> <li>• Developing green belt in irrigation area</li> <li>• Reduce use of excess industrial fertilizer by using compost or organic fertilizer</li> </ul>
			√		Water logging due to improper drainage of excess water will cause production of GHG (Methane) due to soil oxygen deficiency (anoxia)	<ul style="list-style-type: none"> <li>• Avoid unnecessary use of water</li> <li>• Proper drainage design</li> </ul>
<b>Impacts on Socio-economy</b>						
Change in population size	√	√	√		As irrigated agriculture demands much labor, influxes of migrant laborers were attracted from the surrounding area and boosted the laborers population size of the irrigation area	<ul style="list-style-type: none"> <li>• Give priority on job opportunity to local youth</li> </ul>
Economy	√	√	√	√	Shift in way of life –from pastorals to farming practice – this may challenge the economy of the area especial at initial stage the project practice	<ul style="list-style-type: none"> <li>• Training and demonstration to the newly introduced technology</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
					due to lack of experience	
Women work load, absence from education and sexual harassment		√	√	√	Irrigation intentionally hires women for work which poses work load on them.	<ul style="list-style-type: none"> <li>• Give equal chance to all</li> </ul>
	√	√	√		Absence from school due to engagement of women on irrigation project	<ul style="list-style-type: none"> <li>• Work shift for the m to learn</li> <li>• Reduce other workloads at home</li> </ul>
					Women may be exposed to sexual harassment	<ul style="list-style-type: none"> <li>• Proper orientation for harassment protection</li> <li>• Mainstreaming in gender issues in irrigation</li> </ul>
Displacement	√	√			Displacement of population from their land and home	<ul style="list-style-type: none"> <li>• Compensation</li> </ul>
Land Acquisition and Loss of livelihood	√	√			The most adverse socioeconomic impacts of the irrigation project are the dispossession of farmland and displacement of farmers from their agricultural land and residences.	<ul style="list-style-type: none"> <li>• Compensation</li> <li>• Share holder</li> <li>• Safety net program</li> </ul>
	√	√			Impacts on Housing Structures and Homesteads (Involuntary Resettlement)	<ul style="list-style-type: none"> <li>• Compensation for house and homesteads</li> </ul>
Disruption of Social and Cultural Ties	√	√	√		A sense that they feel some discomfort and fear of the disruption of their social and cultural ties due to displacement.	<ul style="list-style-type: none"> <li>• Reconstruct the social ties at the new location</li> </ul>
Impacts on Public, health, Community Institutions and infrastructures	√	√			Impact on social services and facilities like public buildings, schools, health facilities, water supply and religious institutions (churches and mosques), destruction of existing roads and a railway that extends at premises of the irrigation projects	<ul style="list-style-type: none"> <li>• Construction of new infrastructure for the destroyed once</li> </ul>
Social evils	√	√	√		Increased financial flow, social evils (Drug abuse, unwanted pregnancies and violence), boom and bust phenomenon associated with temporary labor contracts	<ul style="list-style-type: none"> <li>• Increase awareness of all workers and the surrounding community members on fighting social evils</li> </ul>
Increased level of disease vectors	√	√	√		Wastes disposed haphazardly form micro-environments for breeding of disease vectors. The crevices could provide habitats for mosquitoes, rats, cockroaches, flies.	<ul style="list-style-type: none"> <li>• Proper waste disposal and hierarchical waste management sytem</li> <li>• Avoid pest and mosquito breeding grounds</li> </ul>
Public health		√	√		Increased incidence of water-related disease such as diarrhea, malaria or sleeping sickness Risk of introduction of new diseases as schistosomias is	<ul style="list-style-type: none"> <li>• Avoid pest and mosquito breeding grounds</li> <li>• Spray chemicals</li> <li>• Vaccination</li> <li>• Proper water treatment</li> <li>• Optional water supply</li> <li>• Avoid water pollution by chemicals and fertilizers</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
		√	√		Communicable diseases Construction activities: in irrigation projects may pose labor to the project site which may bring communicable diseases (HIV/AIDS, COVID-19, etc)	<ul style="list-style-type: none"> <li>• Provision of appropriate personal protective equipments( PPE s)</li> <li>• Provision of condoms</li> <li>• Training on sexual transmitted diseases(STD) to workers</li> <li>• Conducting awareness creation and raising programs</li> </ul>
<b>Occupational health and safety</b>		√	√		<b>Chemical Exposures/Poisonings</b> —Result in acute and/or long-term health hazards for personnel who handle chemicals, pollution or other products.Workers result in an increased or decreased risk that chemicals are unintentionally spread, by air, water or via food chains, through the use of chemicals, or through poor storage conditions or inadequate facilities for the destruction of waste products	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Dust and other particulate matter</b> - land preparation cause dust re-suspension and vehicles and machineries release dust and particulate matter that health effect on lung function	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers Watering</li> </ul>
		√	√		<b>Machinery and working equipments</b> -Mobile machines such as tractors, front-end loaders, skid-steers, material handlers and forklifts are often used inside and outside agricultural installations for production, daily chores or intermittent maintenance activities. Machines used in agricultural installations may also use buckets, forks or blades for handling manure, feed or other materials. Hazards for these activities may include being crushed by falling objects or materials from buckets and lifts, run-over of co-workers or bystanders, machines slipping off the edges of ramps or building drop-offs	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers Provide signs</li> </ul>
		√	√	√	<b>Electrical Contacts and Fire explosion</b> Overhead power line contacts, short circuits, working on energized equipment, lightning strikes	<ul style="list-style-type: none"> <li>• PPE provision</li> <li>• Training on use of PPE to workers</li> <li>• Provide signs</li> </ul>
		√	√		<b>Contact/Entanglement with Moving Parts</b> -due to the mechanical nature of lifting, pressurizing and transporting water, irrigation pumping plants universally consist of rotating parts. Common rotating components include belt drives, drive shafts, fan blades, pump vanes, right-angle drives, motors, etc	<ul style="list-style-type: none"> <li>• PPE provision</li> <li>• Provide signs</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
		√	√		<b>Falls from height-</b> workers fall from ladder and when working at a height	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Drowning - rivers, lakes, canals, ponds, pits, etc.</b>	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Physical Damage (Head, Eye, Ear, Hand &amp; Foot)</b>	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Ergonomics and heading of materials:</b> Ergonomic factors affect the health outcomes of irrigation workers includes:– the nature of the physical work environment (noise, heat, lighting, thermal comfort), the agricultural tasks to be performed; – the technology applied to the prescribed tasks (including workplace design, facility design, and agricultural material handling); – the manner in which tasks are organized (including use of shift work); and – worker characteristics (including demographics, physiology, human error, and identification and treatment of injured workers).	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Vibration-</b> vibration of machinery and vehicles	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
			√		<b>Waste-</b> workers exposed to both liquid and solid wastes from irrigation	<ul style="list-style-type: none"> <li>• Proper waste management</li> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
			√	√	<b>Injury from wild animals</b> –Insects, snakes bites	<ul style="list-style-type: none"> <li>• Prepare sufficient first aid</li> <li>• Prepare health services</li> <li>• Clear sites</li> <li>• PPE provision and awareness on how to use</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
						<ul style="list-style-type: none"> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Noise exposure</b> – machines and vehicles produce noise that can affect the hearing of the workers and permanent damage to ears	<ul style="list-style-type: none"> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers (Ear plugs)</li> <li>• Grease and service machineries and vehicles</li> </ul>
		√	√		<b>Confined space</b> –Entry into confined spaces can pose very serious risks for workers, including suffocation and drowning	<ul style="list-style-type: none"> <li>• Sufficient ventilation of workplace</li> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
	√	√	√		<b>Traffic accident, fall collision during transportation of material and agricultural product</b> - Agricultural workers use a variety of vehicles for transportation, including buses, trucks, trailers, automobiles, all-terrain vehicles, bicycles and agricultural equipment. Operators and passengers can fall while mounting or dismounting. They can fall within or from vehicles during transport. They can be injured by contact with interior paneling or fixtures, other persons, or objects during unexpected stops and starts or in a turnover or collision. Often oxen, donkeys, mules, etc., are often used as a means of transport of people, equipment and goods.	<ul style="list-style-type: none"> <li>• Place rules in control of speed limits</li> <li>• Control speed limits of vehicles around the project sites</li> <li>• Prepare proper Parking area</li> <li>• Aware drivers for their speed limits</li> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
		√	√		<b>Exposure to bad weather /climate</b> – irrigation is mostly practiced at outdoor at very hot and cold climate conditions	<ul style="list-style-type: none"> <li>• Proper cooling and ventilation of work places in dessert areas</li> <li>• Proper heating of the work place in cold areas</li> <li>• Evacuation plan preparation</li> <li>• PPE provision and awareness on how to use</li> <li>• Use safety instructions properly</li> <li>• Training on health and safety issues and on the use of PPE to workers</li> </ul>
Loss of jobs				√	After decommission the employers might loss job	<ul style="list-style-type: none"> <li>• Create alternative job opportunity to the workers</li> </ul>
Life cycle impact	√	√	√	√	The product life cycle impact on the environment (packing material nature; specially lack of biodegradability)	<ul style="list-style-type: none"> <li>• Use of biodegradable materials in the life cycles of the project</li> </ul>

Expected impact	PCP (7)	CP (8)	OP (9)	DP (10)	Detail of impacts	
<b>Grievance Redressing Mechanism</b>						
<b>Complaints /grievances and Conflicts</b>	√	√	√		Grievances resulting from incompatibility to the local culture, competition over employment, loss of control / income of land, flood from irrigation project	<ul style="list-style-type: none"> <li>• Training of the proponents to respect the local culture and norms</li> <li>• Establish conflict resolution committee</li> <li>• Make aware the proponent on the culture and norms in the project area and to respect those local culture and norms</li> <li>• Create awareness on the regional, national and international policies and regulations about such projects</li> <li>• Establish conflict resolution committee incorporating from the PAPs and community</li> <li>• Conflict resolution document preparation</li> <li>• Workers and employers participation in conflict resolution</li> <li>• Share job opportunity</li> <li>• Teach about the project</li> </ul>
	√	√	√		Labour issues are always a source of friction between companies and communities and also among community members.	
	√	√	√		When problem is not solved timely the risk level for the project may dramatically increase	
					Communities/stakeholders and project affected people may turn to protest and conflict on the benefit and level of affection from the project	

## 8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Environmental and social management plan has encouraged governments and agencies to require proponents to avoid or minimize impacts through good design or design modifications (mitigation) and produce plans for managing impacts so that these are kept within the acceptable limits.

### 8.1. Environmental and Socio-economic Plan (ESMP)

Enhancement and mitigation plan is the core of an ESIA report. It contains two major issues; impact enhancement and mitigation measures and their managements plan.

Project owner is expected to implement the recommended environmental and social management activities with accountabilities. To undertake ESMP activities of this section:

- Distinguish and indicate activities of each phase i.e. design or pre-construction phase, construction phase and operation phase.
- Based on the project site environmental and social baseline conditions, project locations and activities nature; distinguish possible adverse impacts of the project.
- Indicate clearly mitigation measures for each.
- Assign responsible body or bodies for each recommended mitigation measures based on careers in the project assignment, their institutional roles and responsibilities (Including enforcement & coordination) of their institutional establishment.
- Distinguish the impacts and their mitigation measures by project phases.
- Estimate budget for the implementation of the recommended mitigation measures.

ESIA team /consultant need to summarize the activities stated as enhancement and mitigation plan of the irrigation projects using template shown in Table 18 and for additional reference of Table 22 Annex IV can be used.

**Table 18: Template for environmental and socio-economic impacts plan (ESMP) preparation**

Phases of the project	Potential Environmental Impact	Proposed Enhancement or mitigation measures	Schedule for implementation of enhancement or mitigation measures	Responsible individual / institution	Cost Estimated
<b>PHYSICOCHEMICAL ENVIRONMENT</b>					
Pre-construction					
Construction					
Operation					
Decommissioning/Closing					
<b>BIOLOGICAL ENVIRONMENT</b>					
Pre-construction					
Construction					
Operation					
Decommissioning/Closing					
<b>SOCIO-ECONOMIC</b>					
Pre-construction					
Construction					
Operation					
Decommissioning/Closing					

## 8.2. Environmental and Social Monitoring Plan

Environmental and social monitoring aims at ensuring effectiveness of implementations of the recommended environmental and social enhancement and mitigation measures through periodical follow up. The monitoring is, expected to be conducted during project design or pre-construction, construction and operation phases.

Monitoring activities give responses for questions what, why, where, who and how the recommended mitigation measures implemented.



- Understand that the basis for the monitoring activities is the recommended mitigation measures.
- Distinguish and write down the parameter/s to be monitored for each recommended mitigation measures in each project phases,
- Indicate monitoring indicators based on the project conditions and contexts,
- Indicate where the monitoring activities are to be undertaken or implemented.
- Write down how you or the monitoring team ensures/s its implementations.
- Indicate how many times the monitoring activities should be done in a year or more in order to ensure proper implementation,
- Indicate who undertakes the monitoring activities, and
- Recommended financial needs for the implementation of the monitoring activities.

Environmental and social monitoring plan need to prepared as summarized in the template shown in Table 19 and additional reference can be obtained from Table 23 of the annex IV.

**Table 19: Template for summarizing Environmental and Social Monitoring Plan**

Phases of the project	Enhancement and Mitigation Measures	Parameters To be Monitored	Approaches to be followed to monitor each parameter	Frequency of measurement	Responsible institution	Cost Estimated
Pre-construction						
Construction						
Operation						
Decommissioning/Closing						

## 9. ENVIRONMENTAL AND SOCIAL AUDIT

ESIA procedural guideline series-1 (EFCCC, 2003) indicates that environmental and social audit is conducted at various stages of the project implementation. It indicates that environmental and social audit is expected at the corresponding levels in project cycles and a step wise approval shall be done. The environmental and social audit is expected to be made to evaluate implementations of the recommended environmental and social enhancement and mitigation measures indicated in the environmental and social management plan of the project.

### 9.1. Environmental and social audit process

Environmental audit process is usually categorized into three stages; pre-audit activities, onsite audit activities and post audit reporting (EFCC, 2006) that could be conduct internally by the project owner and externally by the consultant firm( also called performance audit).

#### Pre-audit activities

The pre-audit activities is environmental and social audit planning of the audit itself. Planning is fundamental to the success and it is vital in having clear idea of what is to be achieved, how the audit is conducted and what the follow-up mechanism will be in minimizing time spent on audit activities and prepare audit team in operating at maximum productivity throughout the audit program.

#### Onsite audit activities

The execution of the audit in the industrial enterprises (i.e. onsite) involves among others an opening meeting, site tour/inspection, collection of information/evidence, evaluation and verifications, team meetings, preparation of findings and a close out meeting.

#### Post audit reporting

The final stage of the audit involves producing an audit report in which the audit findings, conclusions and recommendations are presented. The wording of the findings should not deviate from those agreed upon in the closing meeting. The environmental and socio-economic audit of the irrigation project need to conducted mainly including but not limited to information given in Table 20.

**Table 20: Environmental and social audit activities and schedule**

S. No	Activities	Date	Remarks
<b>1</b>	<b>Pre-site activities</b>		
1.1	Selection of team members		
1.2	Preparation of working document by listing down the major adverse impacts with their mitigation measures shown in the EMP.		
<b>2</b>	<b>On-site activities</b>		
2.1	Opening meeting with the project proponent		
2.2	Conducting site investigations		
	Identifying the major adverse impacts status and implementation of the recommended major mitigation measures for the listed most possible adverse impacts of the IP activities.		
2.3	Data gathering / Collecting evidences		
	Interview, examining documents, taking photographs and photocopies of documents where necessary, etc.		
2.4	Verification		
	Ensuring gathered data by cross checking with other sources such as procedures and guidelines.		
2.5	Evaluation and site investigation closing		
	<ul style="list-style-type: none"> <li>Classifying and analyzing environmental and social audit findings.</li> <li>Identifying major environmental and social problems or issues of the IP activities and indicate their significance.</li> <li>Assessing non-compliance activities.</li> <li>Checking effectiveness of corrective actions.</li> <li>Identifying improvements.</li> <li>Formulating recommendations.</li> <li>Discussing findings with the project promoter.</li> <li>Closing meeting.</li> </ul>		
<b>3</b>	<b>Post-site activities</b>		
3.1	Draft audit report preparation.		
3.2	Submission of the report to project promoter for comment.		
3.3	Receive comments and finalizing the report		
3.3	Issue final audit report to project promoter.		

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## ANNEXES

## Annex-I: ESIA report format

- i. Executive Summary
  - ii. Introduction
  - iii. Project Description
  - iv. Project stakeholders and public involvement
  - v. Description of Institutional, Policy and Legislative Environment
  - vi. Description of baseline Environment
  - vii. Environmental and Social Impacts analysis
  - viii. Impact enhancement and mitigation plan
  - ix. Environmental and Social monitoring plan
  - x. Environmental and Social audit plan
  - xi. Summary and Recommendations
- References
- Appendices

## Annex-II: Water resources and supply baseline data collection format

### 1. Potable water supply coverage of:

- 1.1. Woreda water supply coverage..... = \_\_\_\_\_ %
- 1.2. Urban water supply coverage ..... = \_\_\_\_\_ %
- 1.3. Rural water supply coverage ..... = \_\_\_\_\_ %

### 2. The sources, number and percent coverage of potable water supply for the Woreda.

<u>Sources</u>	<u>Number</u>	<u>Percent coverage</u>
<input type="checkbox"/> Springs .....	_____	= _____ %
<input type="checkbox"/> River.....	_____	= _____ %
<input type="checkbox"/> Pipe .....	_____	= _____ %
<input type="checkbox"/> Hand dug well .....	_____	= _____ %
<input type="checkbox"/> Others (if any, specify).....	_____	= _____ %

### 3. The sources, number and percent coverage of potable water of *project Kebele* (If available).

<u>Sources</u>	<u>Number</u>	<u>Percent coverage</u>
<input type="checkbox"/> Springs .....	_____	= _____ %
<input type="checkbox"/> River.....	_____	= _____ %
<input type="checkbox"/> Pipe .....	_____	= _____ %
<input type="checkbox"/> Hand dug well .....	_____	= _____ %
<input type="checkbox"/> Others (if any, specify).....	_____	= _____ %

### 4. Water resources at the proposed irrigation project site.

#### 4.1. Are there any water sources around the proposed IP site?

- A. Yes                      B. No

#### 4.2. If yes, is there any effect/s of the IP on the water resources?

- A. Yes                      B. No

#### 4.3. Any expected negative impact/s of the proposed IP on the water resources and supply of the area? If any, list briefly.

\_\_\_\_\_

#### 4.4. What should be done to protect or control the expected impacts of the IP?

\_\_\_\_\_

### 5. Any \_\_\_\_\_ additional \_\_\_\_\_ comment.

Responder's name : \_\_\_\_\_ Signature \_\_\_\_\_

Job title or position : \_\_\_\_\_

Institution : \_\_\_\_\_

Address: Region : \_\_\_\_\_ Zone : \_\_\_\_\_

Woreda : \_\_\_\_\_ Town : \_\_\_\_\_

Telephone: \_\_\_\_\_ Date : \_\_\_\_\_

### Annex-III: Permissible water quality concentration for irrigation

Description	Ethiopian Standard (mg/l)	WHO Maximum allowable concentration for irrigation (mg/l)	Sample result	Remark
Sample source				
Sample Collection Date				
Sample Submission Date				
Turbidity (NTU)	-	5.0		
Total solids 105 <sup>0</sup> C (mg/l)	-	-		
Total Dissolved Solids 105 <sup>0</sup> C (mg/l)	1000	1000.0		
Electrical Conductivity (μS/cm)	-	700 – 3000		
pH	6-9	6.5 – 8.4		
Ammonia (mg/l NH <sub>3</sub> )	0.2	-		
Nitrite (mg/l NO <sub>2</sub> )	0.1	-		
Nitrate (mg/l NO <sub>3</sub> )	10	45.0		
Sodium (mg/l Na)	-	230		
Potassium (mg/l K)	-	-		
Total hardness (mg/l CaCO <sub>3</sub> )	-	500.0		
Calcium (mg/l Ca)	-	200.0		
Magnesium (mg/l Mg)	-	150.0		
Manganese	1.5 *	-		
Total Iron (mg/l Fe)	0.3	0.3		
Fluoride (mg/l F)	1.5	1.50		
Chloride (mg/l Cl)	250	250.0		
Carbonate (mg/l CO <sub>3</sub> )	-	-		
Bicarbonate (mg/l HCO <sub>3</sub> )	520	-		
SAR (calculated)	-	-		

Source: \* FAO Irrigation and Drainage Paper, Rome, 1985.

#### SAR or Na hazards:

Below 2- no hazard, 2 to 10 as little hazards, 7 to 18 medium hazards, 11 to 26 high hazards and over 26 very high hazards (Ftter, 1994).



## Annex IV: Impact analysis, management, and monitoring plan tables

**Table 21: Impact significance evaluation matrix (Sample)**

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance (‘HS <sup>16</sup> ’, MS <sup>17</sup> ‘S <sup>18</sup> ’ and ‘NS <sup>19</sup> ’)
<b>Beneficial impacts</b>							
Increased incomes and income base, Food availability and Poverty reduction	Increased crop productivity and food security and break the cycle of poverty						
	Access to irrigation allows people to not only increase their production and incomes, but also enhances their opportunities to diversify their income base, and to reduce their vulnerability to the seasonality of agricultural production and external shocks						
	It should be noted that the poor also use water for other farm and non-farm production activities, particularly small-scale rural enterprises such as livestock rearing, fish production, brick making and so on.						
	Irrigation increased crop output through increases in yield especially by making crop production possible in places where rainfall and soil moisture are insufficient throughout year-round farm.						
	Irrigation enables smallholders to adopt more diversified cropping patterns, and to switch from low value staple production to high-value market-oriented production. Increased production makes food available and affordable for the poor by increasing purchasing power						
Import substitution	The country is spending relatively huge amount of money for imports of various products which can be replaced by production						

<sup>11</sup> Extent of impact

<sup>12</sup> Intensity of impact

<sup>13</sup> Duration of impact

<sup>14</sup> Consequence of impact

<sup>15</sup> Probability of occurrence

<sup>16</sup> Highly significant

<sup>17</sup> Moderately significant

<sup>18</sup> Significant

<sup>19</sup> Non Significant

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS' <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
Promotion of export and generation of foreign exchange	Increases the foreign exchange by promoting export based production						
Improving the quality and living standards of citizens							
Increment in the Gross Domestic Product (GDP)							
Creation of eco-friendly environment	Development of conveniences and large scale green parks along existing streams and canals will be established which will make the place more pleasant and attractive for workers and communities						
Increment in employment	Because of the labor intensive nature of irrigation huge employment opportunity created for people around and beyond the irrigation project area						
Better microclimate	Creation of a better microclimate in the irrigation project area, due to development of green belt around the irrigation project area						
Access to infrastructures and services	Establishment a transport link related to irrigation project which may include all weather roads and a railway that may extend into the premises of the irrigation projects giving easy access for import and export of goods for local community						
	Development of Health Post or Clinic in any of the near the irrigation project area which can provide from low level to medium level of health services						
	Construction of religious sites						
	Construction of Water Supply and Sanitation						
	Development of modern communication systems such as telephone lines, internet, satellite television, and short-range radio communications irrigation to the irrigation project.						
	The population of the irrigation project area is being served by the nearest fuel stations, postal office, a bank, court and police station services that may develop in the immediate vicinity of the irrigation project.						
Other Livelihood benefits	Enhancement of skill transfer, capacity building and technology transfer						
	Compensation for losses						
	Access to irrigated land, for adversely affected populations and the poor						
Enhancement of market and investment project area	Boost micro-investment in the project area						
Experience sharing in Environmental management	Watershed management, Water quality, Water use increase						
	Protection of vegetation, habitats and specific ecosystems						
	Water access and rights, Land uses, Natural resources management and Agricultural practices						

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
	Sanitation and hygienic conditions						
	Food supply and safe drinking water						
Gender	Reduce women's workload, Control over land and land proceeds, Income-generating activities, Access to facilities and services and Women's involvement in decision-making processes						
Construction of Religion sites and Schools	Construction and maintenance of religious areas, cultural or historic value, and cultural monuments						
<b>Adverse impacts</b>							
<b>Physicochemical impacts</b>							
Land use change	Existing pastoral farmland or bushes, forest changed to irrigation land and these could be linked to adverse impact on soil erosion, precipitation and hydrological impacts as a result of water abstraction, agrochemical water pollution and siltation						
Land and soil degradation	<b>Salinization:</b> Agricultural land takes nutrient and by leaving salt in the soil. Similarly evaporation reduces water and increasing salt in the irrigated soil. Salinity risks also increases when saline water is used for irrigation and when poor fertilizer and poor irrigation management are combined						
	<b>Alkalization:</b> by an increase in the concentration of Na <sup>+</sup> + K <sup>+</sup> , HCO <sub>3</sub> <sup>-</sup> , and TDS in soil from fertilizers and chemical use						
	<b>Water logging:</b> It occurs when there is too much water in a plant's root zone, which decreases the oxygen available to roots. Water logging results primarily from inadequate drainage and over-irrigation and, to a lesser extent, from seepage from canals and ditches						
	<b>Soil acidification:</b> Soil acidification occurs because the concentration of hydrogen ions increases in the soil, Ammonium-based fertilizers are the major contributors to soil acidification, especially if the nitrogen is leached rather than taken up by plants/crops, Ammonium nitrogen from fertilizer or soil organic matter is readily converted to nitrate and hydrogen ions by bacteria in the soil. Removal of plant and animal products leads to leaching of excess nitrate						
	<b>Loss of soil fertility:</b> All crop residue and green byproducts are removed from the field for livestock feed, fuel and house construction, Nutrients are removed more rapidly than they are replaced and can cause loss in soil health Furrow & flood irrigation along the slope leads to soil loss and nutrient depletion						
	<b>Reduction in irrigation water quality:</b> which have been practiced for very different lengths of time in varying climatic and economic circumstances. Thus it is to be expected that the						

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
Water consumption, impact on Water availability and Water pollution	environmental impacts will also be highly variable by country and by region						
	<b>Water quality problems for downstream:</b> Drainage of surface and groundwater in the irrigation project area, which waters may be salinized and polluted by agricultural chemicals like biocides and fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for industrial, municipal and household use, Use of waste water for irrigation						
	<b>Shortage of water availability especially for downstream community:</b> upper stream water abstraction for irrigation can cause decrease in the availability of surface water or ground water, locally or regionally down stream community.						
	<b>Ground and surface water depletion:</b> An irrigation scheme draws water from groundwater, rivers, lakes or overland flow, there for withdrawn for irrigation has impacts on rivers , lakes and ground water reduction						
	<b>Dry drinking &amp; irrigation well:</b> Some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases						
	<b>Reduced base flow / wetlands:</b> If they exceed the natural recharge rates of the aquifers concerned, can lower water tables and thereby reduce flows into wetlands and rivers						
	<b>Agrochemical pollution:</b> Nonpoint source pollution, unlike pollution from point sources such as industrial and sewage treatment plants, comes from many diffuse sources of irrigation project(s), etc						
Siltation	Silting of canals, water bodies and dams contributes to sediment loads and turbidity which affect fish and other aquatic organisms						
Biological impacts							
Forest and bush clearance	Loss of habitat for animals, and conversion of biodiversity rich natural and semi natural habitats to crop production (to irrigation project)						
	Bush encroachment resulting from selective grazing						
	Bush fires and other human interaction						
	Changes to the structure and botanical composition or natural vegetation as a result of forest and bush clearance for need of irrigation land.						
	Loss in pasture land						
	Overuse of the vegetation combined with excessive trampling leads to soil compaction and reduction in plant cover						
	Degradation of rangelands due to livestock diversification,						
	Excessive use of resource if animal numbers allowed building up (ie. Not consumed locally or marketed)						

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS' <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
Poisoning of grazing land	Poisoning of animals grazing the area where pesticides is pumped, dripped off treated livestock or deposited by spray from a spray race						
Prevalence of disease causing microorganisms and insects	Increase in prevalence of malaria due to construction of livestock watering points						
	Increase in tsetse fly and mosquito population due to dam and pond establishment for irrigation purpose						
Fisheries, Amphibians and Reptiles	Aquatic and wetland species may suffer as a result of the drying out of wetlands, or lowered flow and increased temperature in rivers, as a result of abstraction of water for irrigation						
Birds in the project area	Migration of birds, decline in population of birds related to habitat decline and habitat modification in relation to irrigation project						
	Toxicity to birds, which ingest poisoned ticks						
Soil Microorganisms (Fungi, Bacteria and Actinomycete)	Various chemicals and nutrients used for irrigation have adverse impacts on soil and aquatic microorganism and on their interaction						
<b>Impacts on Ecological, Ecosystem function and services not limited to:</b>	.						
Biodiversity loss and risks	Reduced bio-diversity due to water abstraction pollution, forest and bush clearance						
	Migration and productivity of fish species						
	Changes in primary productivity due to biochemical reactions						
	Risk of eutrophication / growth of non-native and/or invasive species						
	Opportunistic growth of aquatic macrophytes in the littoral and sub-littoral zone of the aquatic environment						
	Creation of favorable habitats for the growth and proliferation of disease vectors						
	Irrigation can also bring new risks beyond the farm scale, for example as related to crop disease and diversity as demand for traditional varieties decline						
	Damage to downstream ecosystems due to reduced water quantity, quality and sedimentation						
Ecological function	Adverse impacts on ecological function such as carbon storage, nutrient cycling, water air purification, diseases regulation, Soil formation, primary production and pollination						
Ecosystem services  - Habitat service loss	Silting of water bodies and dams contributes to sediment loads and turbidity which affect fishery and other aquatic ecosystem services.						
	Existing water resource's functions and services (cleaning, drinking, etc)						
	Existing vegetation resource's functions and services (medicinal, energy, etc)						
	Existing land resource's functions and services (grazing land, communal land, forest land, etc)						
	Habitats/ecosystems reserved for special interest such as conservation, scientific importance, recreational value, etc.,						

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS' <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
<ul style="list-style-type: none"> <li>- Impact on economic Service/supporting service</li> <li>- Impacts on social Service/cultural services</li> <li>- etc</li> </ul>	Habitats designated for wildlife conservation such as National Parks, Wildlife Sanctuaries, Loss of Wildlife Reserves and Controlled Hunting Areas						
	(Loss of home for various wildlife)						
	Loss of provision such as fresh water, genetic resources, timber, food, fuel and bio-products						
	Loss of social and cultural benefits such as recreation, traditional resource uses and spirituality, education service, aesthetic value						
<b>Disaster Risks not limited to:</b>	.						
Flooding, disease, pests and disease infestations, land slide, etc	Failure of irrigation dam, canals and other irrigation infrastructures may result in flood occurrences						
	Human and livestock disease epidemics						
	Crop pests,						
	Earthquake related to irrigation dam						
	Land slide,						
<b>Contribution to Weather and Climate change</b>							
Change in atmospheric circulation	Irrigation has immediate effects on the provision of moisture to the atmosphere, inducing atmospheric instabilities and increasing downwind rainfall, or in other cases modifies the atmospheric circulation, delivering rain to different downwind areas.						
	Precipitation and Temperature change						
	Evaporation will increase due to irrigation activities and causes more water vapor (GHG)						
Green house gaseous (GHG) emission	Land Use Change due to irrigation is responsible for global greenhouse gas emissions, principally from deforestation which more related to greater temperature variations, decreased proportions of soil retention of carbon, and changes in precipitation Repetitive ploughing causes change in soil physicochemical properties that finally leads to more soil microbial respiration which releases GHG.						
	Water logging due to improper drainage of excess water will cause production of GHG (Methane) due to soil oxygen deficiency (anoxia)						
<b>Impacts on Socio-economy</b>							
Change in population size	As irrigated agriculture demands much labor, influxes of migrant laborers were attracted from the surrounding area and boosted the laborers population size of the irrigation area						
Economy	Shift in way of life –from pastorals to farming practice – this may challenge the economy of the area especial at initial stage the project practice due to lack of						

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
	experience						
Women and men work load, absence from education and sexual harassment	Irrigation intentionally hinders women for work which poses work load on them.						
	Absence from school due to engagement of women and men on irrigation project						
	Women may be exposed to sexual harassment						
Displacement	Displacement of population from their land and home due to implementation of irrigation project						
Land Acquisition and Loss of livelihood	The most adverse socioeconomic impacts of the irrigation project are the dispossession of farmland and displacement of farmers from their agricultural land and residences.						
	Impacts on Housing Structures and Homesteads (Involuntary Resettlement)						
Disruption of Social and Cultural Ties	A sense that they feel some discomfort and fear of the disruption of their social and cultural ties due to displacement.						
Impacts on Public, health, Community Institutions and infrastructures	Impact on social services and facilities like public buildings, schools, health facilities, water supply and religious institutions (churches and mosques), destruction of existing roads and a railway that extends at premises of the irrigation projects						
Social evils	Increased financial flow, social evils (Drug abuse, unwanted pregnancies and violence), boom and bust phenomenon associated with temporary labor contracts influxes						
Increased level of disease vectors	Wastes disposed haphazardly form micro-environments for breeding of disease vectors. The crevices could provide habitats for mosquitoes, rats, cockroaches, flies.						
Public health	Increased incidence of water-related disease such as diarrhea, malaria or sleeping sickness						
	Risk of introduction of new diseases as schistosomiasis is						
	Communicable diseases: irrigation projects may influxes labour to the project site along which may bring communicable diseases (HIV/AIDS, COVID-19, etc)						
Occupational health and safety	<b>Chemical Exposures/Poisonings</b> —Result in acute and/or long-term health hazards for personnel who handle chemicals, pollution or other products, or reduce such risks. Workers result in an increased or decreased risk that chemicals are unintentionally spread, by air, water or via food chains, through the use of chemicals, or through poor storage conditions or inadequate facilities for the destruction of waste products						
	<b>Dust and other particulate matter</b> - land preparation for irrigation can cause dust re-suspension and vehicles and machineries release dust and particulate matter that health effect on lung function						
	<b>Machinery and working equipment</b> -Mobile machines such as tractors, front-end loaders, skid-steers, material handlers and forklifts are often used inside and outside agricultural installations for production, daily chores or intermittent maintenance activities. Machines						

Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance ('HS' <sup>16</sup> , MS <sup>17</sup> , 'S' <sup>18</sup> and 'NS' <sup>19</sup> )
	used in agricultural installations may also use buckets, forks or blades for handling manure, feed or other materials. Hazards for these activities may include being crushed by falling objects or materials from buckets and lifts, run-over of co-workers or bystanders, machines slipping off the edges of ramps or building drop-offs						
	<b>Electrical Contacts and Fire explosion</b> Overhead power line contacts, short circuits, working on energized equipment, lightning strikes.						
	<b>Contact/Entanglement with Moving Parts</b> -due to the mechanical nature of lifting, pressurizing and transporting water, irrigation pumping plants universally consist of rotating parts. Common rotating components include belt drives, drive shafts, fan blades, pump vanes, right-angle drives, motors, etc.						
	<b>Falls from height</b> - workers fall from ladder and when working at a height						
	<b>Drowning - rivers, lakes, canals, ponds, pits, etc.</b>						
	<b>Physical Damage (Head, Eye, Ear, Hand &amp; Foot)</b>						
	<b>Ergonomics and heading of materials:</b> Ergonomic factors affect the health outcomes of irrigation workers includes:- the nature of the physical work environment (noise, heat, lighting, thermal comfort), the agricultural tasks to be performed; – the technology applied to the prescribed tasks (including workplace design, facility design, and agricultural material handling); – the manner in which tasks are organized (including use of shift work); and – worker characteristics (including demographics, physiology, human error, and identification and treatment of injured workers).						
	<b>Vibration</b> - vibration of machinery and vehicles used for irrigation project can cause excess vibration if not properly maintained and if not regularly got service						
	<b>Waste</b> - workers exposed to both liquid and solid wastes from irrigation						
	<b>Injury from wild animals</b> –Insects, snakes bites						
	<b>Noise exposure</b> – machines and vehicles produce noise that can affect the hearing of the workers and permanent damage to ears						
	<b>Confined space</b> -Entry into confined spaces can pose very serious risks for workers, including suffocation and drowning						
	<b>Traffic accident, fall collision during transportation of material and agricultural product</b> -Agricultural workers use a variety of vehicles for transportation, including buses, trucks, trailers, automobiles, all-terrain vehicles, bicycles and agricultural equipment. Operators and passengers can fall while mounting or dismounting. They can fall within or from vehicles during transport. They can be injured by contact with interior						



Expected impact	Detail of impacts	E <sup>11</sup>	I <sup>12</sup>	D <sup>13</sup>	C <sup>14</sup>	P <sup>15</sup>	Impact significance (‘HS <sup>16</sup> ’, MS <sup>17</sup> ‘S <sup>18</sup> ’ and ‘NS <sup>19</sup> ’)
	paneling or fixtures, other persons, or objects during unexpected stops and starts or in a turnover or collision. Often oxen, donkeys, mules, etc., are often used as a means of transport of people, equipment and goods. There is risks resulting in the case						
	<b>Exposure to bad weather /climate</b> – irrigation is mostly practiced at outdoor at very hot and cold climate conditions						
Loss of jobs	After decommission the employers might loss job						
Life cycle impact	The product life cycle impact on the environment (packing material nature; specially lack of biodegradability)						
<b>Complaints/grievances and Conflicts</b>	Grievances resulting from incompatibility to the local culture, competition over employment, loss of control / income of land, flood from irrigation project						
	Labour issues are always a source of friction between companies and communities and also among community members.						
	When problem is not solved timely and the risk level for the project may dramatically increase						
	Communities/stakeholders and project affected person may turn to protest and conflict which needs Grievances redness mechanisms						

**Table 22: Environmental and Social Management Plan**

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
<b>Beneficial impacts</b>									
Increased incomes and income base, Food availability and Poverty reduction	√	√	√	√	Increased crop productivity and food security and break the cycle of poverty	<ul style="list-style-type: none"> <li>• Give preference to local employment (men and women) and local inputs (food, basic material) to the extent possible.</li> <li>• Ensure that revenues generated by crop production activities are sufficient to cover the cost of irrigation infrastructures construction and maintenance.</li> <li>• Base profitability projections on conservative revenue assumptions.</li> <li>• Whenever possible, give priority access to irrigated schemes to men and women who are losing productive means (owners and people cultivating the land).</li> <li>• Ensure that compensations cover all revenue and asset losses by adversely affected men and women, either if they are landowners or users.</li> <li>• Identify why specific groups are not benefiting from the project and adopt corrective measures as required, such as favouring excluded groups when irrigated schemes are reallocated or expanded.</li> <li>• Ensure that women are directly paid for their work, avoiding intermediaries.</li> </ul>			

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
						<ul style="list-style-type: none"> <li>Ensure that not only land owners but also women and men occupying / cultivating the land are compensated for the losses related to the project.</li> <li>Ensure that project promoters do not reinforce cultural barriers affecting negatively women</li> <li>Consider targeting women beneficiaries when inequities exist and persist.</li> </ul>			
		√	√	√	Access to irrigation allows people to not only increase their production and incomes, but also enhances their opportunities to diversify their income base, and to reduce their vulnerability to the seasonality of agricultural production and external shocks	<ul style="list-style-type: none"> <li>Training on diversified income bases</li> </ul>	•	•	•
		√	√	√	It should be noted that the poor also use water for other farm and non-farm production activities, particularly small-scale rural enterprises such as livestock rearing, fish production, brick making and so on.	<ul style="list-style-type: none"> <li>Training on diversified income bases and enhance extension services of the farmers</li> </ul>	•	•	•
		√	√	√	Irrigation increased crop output through increases in yield especially by making crop production possible in places where rainfall and soil	<ul style="list-style-type: none"> <li>Awareness of water conservation, use improved seed varieties, provision of early maturing seed varieties</li> </ul>	•	•	•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					moisture are insufficient throughout year-round farm.				
		√	√	√	Irrigation enables smallholders to adopt more diversified cropping patterns, and to switch from low value staple production to high-value market-oriented production. Increased production makes food available and affordable for the poor by increasing purchasing power	<ul style="list-style-type: none"> <li>Awareness of creation and incentive provision in market oriented production systems</li> </ul>	•	•	•
Import substitution			√		The country is spending relatively huge amount of money for imports of various products which can be replaced by production	<ul style="list-style-type: none"> <li>Awareness creation, incentive provision, market linkage, media coverage for use of locally produced irrigation products as a substitute for imported products</li> </ul>	•	•	•
Promotion of export and generation of foreign exchange			√		Increases the foreign exchange by promoting export based production	<ul style="list-style-type: none"> <li>Awareness of creation and incentive provision export production systems</li> <li>Foreign market linkage creation</li> <li>Easy logistic services</li> </ul>	•	•	•
Improve quality of life			√		Improving the quality and living standards of citizens	<ul style="list-style-type: none"> <li>Increase irrigation sustainability by reducing postharvest losses, providing irrigation and postharvest technologies, etc</li> </ul>	•	•	•
GDP			√		Increment in the Gross Domestic Product	<ul style="list-style-type: none"> <li>Awareness in tax paying and tax collection system</li> <li>Ease tax paying system</li> </ul>	•	•	•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Creation of eco-friendly environment and better microclimate			√		Development of conveniences and large scale green parks along existing streams and canals will be established which will make the place more pleasant and attractive for workers and communities Creation of a better microclimate in the irrigation project area, due to development of green belt around the irrigation project area	<ul style="list-style-type: none"> <li>Awareness creation in greening programs and waste management system</li> <li>Provide place for nursery establishment</li> </ul>	•	•	•
Increment in employment	√	√	√	√	Because of the labour intensive nature of irrigation huge employment opportunity created for people around and beyond the irrigation project area	<ul style="list-style-type: none"> <li>Give preference on job creation to local employment (men and women) and use local inputs (food, basic material) to the extent possible.</li> </ul>	•	•	•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Access to infrastructures and services					<p>Establishment a transport link related to irrigation project which may include all weather roads and a railway that may extend into the premises of the irrigation projects giving easy access for import and export of goods for local community</p> <p>Development of Health Post or Clinic in any of the near the irrigation project area which can provide from low level to medium level of health services</p> <p>Construction of religious sites</p> <p>Construction of Water Supply and Sanitation</p> <p>Development of modern communication systems such as telephone lines, internet, satellite television, and short-range radio communications irrigation to the irrigation project.</p> <p>The population of the irrigation project area is being served by the nearest fuel stations, postal office, a bank, court and police station services that may develop in the immediate vicinity of the irrigation project.</p>	<ul style="list-style-type: none"> <li>During project preparation, consult concerned ministries to verify the adequacy of current and proposed social infrastructures.</li> <li>Involve users, men and women, in the maintenance and management of new infrastructures to ensure their sustainability.</li> <li>Ensure appropriate social services are available to address the basic needs of the host and migrant populations.</li> <li>Assist social service administrations in coordinating their efforts to offer additional services and improve service delivery, if required.</li> <li>Implement consumption fees on irrigation water to finance infrastructure construction and maintenance.</li> <li>Promote safety net measures to protect the poor and other vulnerable groups against price increases in social services.</li> <li>Give awareness to the investor for its corporate social responsibility</li> </ul>			

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Skill transfer, capacity building and technology transfer	√	√	√	√	Skill transfer, capacity building and technology transfer in irrigation	<ul style="list-style-type: none"> <li>Enhancement of skill transfer, capacity building and technology transfer through provision of practical training and demonstration</li> <li>Prepare farmers field day</li> </ul>			•
Enhancement of market and investment project area	√	√	√		Boost micro-investment in the project area	<ul style="list-style-type: none"> <li>Training on better service provision</li> <li>Information provision for consumers of irrigation products</li> </ul>			•
Experience sharing in Environmental management			√	√	Watershed management, Water quality, Water use increase	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>			•
	√	√	√	√	Protection of vegetation, habitats and specific ecosystems	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>			•
		√	√	√	Water access and rights, Land uses, Natural resources management and Agricultural practices	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>			•
			√	√	Sanitation and hygienic conditions	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>			•
			√	√	Food supply and safe drinking water	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>			•
Gender	√	√	√	√	Reduced women's and men's workload, Control over land and land proceeds, Income-generating activities, Access	<ul style="list-style-type: none"> <li>Promote women, men and children with means to reduce the efforts required for water transportation</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					to facilities and services and Women's and men involvement in decision-making processes	(donkey, cart, etc.) and labour intensive work. <ul style="list-style-type: none"> <li>Plan for the expansion of drinking water supply sources and for their location close to human settlements while planning an irrigation project.</li> <li>Plan support initiatives to reduce women's and men reproductive workload.</li> </ul>			
<b>Adverse impacts</b>					<b>Detail impacts</b>	<b>Mitigation measures</b>			
<b>Physicochemical impacts</b>									
Land use change	√	√			Existing pastoral farmers or bushes, forest changed to irrigation land and these could be linked to adverse impact on soil erosion, precipitation and hydrological impacts	<ul style="list-style-type: none"> <li>Increase awareness of the community for the erosion free grazing, avoid unwanted deforestation, rehabilitation afforestation of degraded communal lands, area closure, etc</li> </ul>			•
Land and soil degradation			√	√	<b>Soil compaction and salinization:</b> Agricultural land takes nutrient leaving salt in the soil. Similarly evaporation reduces water and increasing salt in the irrigated soil. Salinity risks also increases when saline water is used for irrigation and when poor fertilizer and poor irrigation management are combined	<ul style="list-style-type: none"> <li>Irrigation technology improvement (Like drip irrigation)</li> <li>Leaching the salts</li> <li>Minimize use of inorganic fertilizer</li> <li>Avoid use of salty water</li> <li>Minimize the use of heavy machinery and limit their circulation to minimal areas.</li> <li>At the end of construction works, level off the soils and facilitate vegetation regeneration.</li> <li>Use existing borrow pits rather than creating new ones; after the works, restore borrow pits by stabilizing</li> </ul>			•



Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
						slopes and facilitating vegetation regeneration. <ul style="list-style-type: none"> <li>• Avoid to clear vegetation along water bodies.</li> <li>• Minimize and clearly define the land clearing areas.</li> <li>• Avoid steep slope and level the land (terrace on slopes) as much as possible.</li> <li>• Maintain vegetation hedges in order to reduce wind erosion.</li> </ul>			
			√	√	<b>Alkalization:</b> by an increase in the concentration of $\text{Na}^+$ + $\text{K}^+$ , $\text{HCO}_3^-$ , and TDS in soil	<ul style="list-style-type: none"> <li>• Irrigation technology improvement (Drip)</li> <li>• Leaching the salts</li> <li>• Minimize use of inorganic fertilizer</li> <li>• Avoid use of salty water</li> </ul>			•
		√	√	√	<b>Water logging:</b> It occurs when there is too much water in a plant's root zone, which decreases the oxygen available to roots. Water logging results primarily from inadequate drainage and over-irrigation and, to a lesser extent, from seepage from canals and ditches	<ul style="list-style-type: none"> <li>• In order to avoid water saturation, regulate adequately the irrigation (avoid excessive irrigation), maintain the drainage network and select an irrigation system that is low demanding in water and appropriate for crops.</li> </ul>			•
			√	√	<b>Soil acidification:</b> Soil acidification occurs because the concentration of hydrogen ions in the soil increases, Ammonium-based fertilizers are the major contributors to soil	<ul style="list-style-type: none"> <li>• Irrigation technology improvement (like drip irrigation)</li> <li>• Leaching the salts using clean water</li> <li>• Minimize use of inorganic fertilizer maximize use of organic fertilizers</li> <li>• Use of lime treatment and bio char</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					acidification, especially if the nitrogen is leached rather than taken up by plants, Ammonium nitrogen from fertilizer or soil organic matter is readily converted to nitrate and hydrogen ions by bacteria in the soil. Removal of plant and animal products leaching of excess nitrate				
		√	√	√	<b>Loss of soil fertility:</b> All crop residue and green byproducts are removed from the field for livestock feed, fuel and house construction, Nutrients are removed more rapidly than they are replaced Furrow & flood irrigation along the slope leads to soil loss and nutrient depletion	<ul style="list-style-type: none"> <li>• Use residues of the crop for self-mulching</li> <li>• Use compost</li> <li>• Use improved irrigation methods (Drip)</li> <li>• Reduce frequency of irrigation</li> <li>• Use of soil and water conservation(SWC) structural measures</li> <li>• Prepare proper drainage</li> </ul>			•
Water consumption, impact on Water availability and Water pollution			√	√	<b>Water quality problems for downstream:</b> Drainage of surface and groundwater in the irrigation project area, which waters may be salinized and polluted by agricultural chemicals like biocides and fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for industrial, municipal and household use,	<ul style="list-style-type: none"> <li>• Maintain vehicles, machinery and equipment in good condition in order to avoid leaks and spill of hazardous materials.</li> <li>• Take all precautions during the refueling of vehicles, machinery and pumps, and forbid the refueling near water bodies.</li> <li>• Ensure a safe management of hazardous materials.</li> <li>• Avoid crossing permanent waterways; if necessary, locate the</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					Use of waste water for irrigation	<p>crossing where the banks are stable and the narrowest.</p> <ul style="list-style-type: none"> <li>• Do not hamper drainage of surface water and plan for restoration measures after construction.</li> <li>• Plan works in areas prone to flooding outside the rainy season.</li> <li>• Install appropriate sanitary facilities in workers' camps.</li> <li>• Adopt a watershed management approach while designing the project.</li> <li>• Minimize the loss of water caused by leaks, evaporation and infiltration through canals and reservoirs (e.g. maintain vegetation along water canals).</li> <li>• Develop compensation measures for affected downstream water users.</li> <li>• Ensure that drainage water complies with discharge standards, treat wastewater accordingly and ensure safe re-use of wastewater.</li> <li>• Design water canals for reducing sedimentation and facilitating drainage and maintenance.</li> <li>• Control access to irrigation water for other purposes than irrigation (safety measures and rules).</li> <li>• Remove aquatic vegetation from margins of water canals and reservoirs.</li> </ul>			

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
						<ul style="list-style-type: none"> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>			
		√	√		<b>Shortage of water availability especially for downstream community:</b> users caused by irrigation return flow quality-cause an increase or decrease in the availability of surface water or ground water, locally or regionally	<ul style="list-style-type: none"> <li>Alternative water sources provision for downstream users</li> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>			•
		√	√		<b>Ground and surface water depletion:</b> An irrigation scheme draws water from groundwater, rivers, lakes or overland flow, therefore withdrawn for irrigation has impacts on rivers , lakes and ground water reduction	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>			•
			√	√	<b>Dry drinking &amp; irrigation well:</b> Some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Practice Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>			•
			√		<b>Reduced base flow / wetlands:</b> If they exceed the natural recharge rates of the aquifers concerned, can lower	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Practice Watershed management</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					water tables and thereby reduce flows into wetlands and rivers	<ul style="list-style-type: none"> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>			
			√	√	<b>Agrochemical pollution:</b> Nonpoint source pollution, unlike pollution from point sources such as industrial and sewage treatment plants, comes from many diffuse sources of irrigation project(s), etc	<ul style="list-style-type: none"> <li>Avoid use of excessive industrial fertilizer</li> <li>Minimize use of pesticide and herbicides, instead weed removal by hand</li> <li>Use bioremediation for pollution treatment</li> </ul>			•
Siltation		√	√		Silting of canals, water bodies and dams contributes to sediment loads and turbidity which affect fish and other aquatic organisms	<ul style="list-style-type: none"> <li>Practice Watershed management</li> <li>Fitting of screens at the inlet from diversions to canals</li> <li>Delineate buffer zone for water bodies</li> </ul>			•
<b>Biological impacts</b>									
Forest and bush clearance	√	√	√		Loss of habitat for animals, and conversion of biodiversity rich natural and semi natural habitats to crop production (to irrigation project)	<ul style="list-style-type: none"> <li>Delineate buffer zone in irrigation side which serve wild life and animals</li> </ul>			•
			√	√	Bush encroachment and bush fires resulting from selective grazing	<ul style="list-style-type: none"> <li>Use cut and carry system rather than releasing cattle to bush and forest</li> <li>Practice area closure around irrigation project</li> </ul>			•
	√	√	√		Changes to the structure and botanical composition or natural vegetation which are not necessarily negative	<ul style="list-style-type: none"> <li>Afforestation of diversified forest varieties</li> <li>Manage sensitive and endangered species</li> <li>In situ or ex situ conservation</li> <li>Reduce cutting of indigenous trees</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
						<ul style="list-style-type: none"> <li>• Apply agroforestry when possible</li> </ul>			
		√	√		Loss in pasture land	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Area closure</li> </ul>			•
		√	√		Overuse of the vegetation combined with excessive trampling leads to soil compaction and reduction in plant cover	Use of cutting and carry system			
		√	√		Degradation of rangelands due to livestock diversification,	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Area closure</li> <li>• Forage plantation</li> </ul>			•
		√	√		Excessive use of resource if animal numbers allowed building up (ie. Not consumed locally or marketed)	<ul style="list-style-type: none"> <li>• Use cut and carry system</li> <li>• Forage plantation</li> </ul>			•
Poisoning of grazing land		√	√		Poisoning of animals grazing the area where pesticides is pumped, dripped off treated livestock or deposited by spray from a spray race	<ul style="list-style-type: none"> <li>• Avoid spilling of agrochemicals in grazing land</li> <li>• Good management of machinery oils and greases</li> </ul>			•
Prevalence of disease causing microorganisms and insects			√		Increase in prevalence of malaria due to construction of livestock watering points	<ul style="list-style-type: none"> <li>• Clean and avoid insect breeding sites such as unnecessary pods and swamp area</li> <li>• Spray chemicals with care</li> </ul>			•
			√		Increase in tsetsefly population	<ul style="list-style-type: none"> <li>• Clean and avoid insect breeding sites</li> <li>• Spray chemicals with care</li> </ul>			•
Fisheries, Amphibians and Reptiles			√		Aquatic and wetland species may suffer as a result of the drying out of wetlands, or lowered flow and increased temperature in rivers, as a result of abstraction for irrigation	<ul style="list-style-type: none"> <li>• Use of alternative water resources</li> <li>• Establishment of buffer zone</li> <li>• Good management of agro-chemicals</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Birds in the project area			√		Migration of birds, decline in population of birds related to habitat decline and habitat modification	<ul style="list-style-type: none"> <li>Minimize unnecessary bird site destruction</li> <li>Avoid unnecessary chemical release and aerial spary</li> </ul>			•
					Toxicity to birds, which ingest poisoned ticks				
Soil Microorganisms (Fungi, Bacteria and Actinomycete)			√		Various chemicals and nutrients used have adverse impacts on soil and aquatic microorganism and on their interaction	<ul style="list-style-type: none"> <li>Avoid use of heavy machinery operations</li> <li>Use of organic fertilizers</li> <li>Avoid use of unnecessary chemicals</li> <li>Use of soil reclaiming seed varieties</li> <li>Reduce erosion</li> </ul>			•
<b>Impacts on Ecological, Ecosystem function and services not limited to:</b>									
Biodiversity loss and risks		√	√		Reduced bio-diversity	<ul style="list-style-type: none"> <li>Afforestation of diversified forest varieties</li> <li>Manage sensitive and endangered species</li> <li>In situ or ex situ conservation</li> <li>Reduce cutting of indigenous trees</li> <li>Apply agroforestry</li> </ul>			•
		√	√		Migration and decrease in fish productivity	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation</li> </ul>			•
		√	√		Changes in primary productivity due to biochemical reactions	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
						<ul style="list-style-type: none"> <li>• Reduce siltation</li> </ul>			
		√	√		Risk of eutrophication / growth of non-native and/or invasive species	<ul style="list-style-type: none"> <li>• Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>• Avoid spill of agrochemicals to water bodies</li> <li>• Reduce siltation</li> </ul>			•
		√	√		Opportunistic growth of aquatic macrophytes in the littoral and sub-littoral zone of the aquatic environment	<ul style="list-style-type: none"> <li>• Reduce siltation</li> <li>• Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>• Avoid spill of agrochemicals to water bodies</li> <li>• Avoid excess water abstraction</li> <li>• Good weed management</li> </ul>			•
		√	√		Irrigation can also bring new risks beyond the farm scale, for example as related to crop disease and diversity as demand for traditional varieties decline	<ul style="list-style-type: none"> <li>• Conservation of traditional varieties</li> <li>• Use of scientifically approved and locally adaptable seed variety</li> <li>• On time spray and weeding</li> </ul>			•
Ecological function			√	√	Adverse impacts on ecological function such as carbon storage, nutrient cycling, water air purification, diseases regulation, Soil formation, primary production and pollination	<ul style="list-style-type: none"> <li>• Increasing carbon sequestration capacity through organic fertilizer application</li> <li>• Avoid repetitive ploughing if possible</li> <li>• Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>• Avoid spill of agrochemicals to water bodies</li> <li>• Avoid excess water abstraction</li> <li>• Good weed management</li> <li>•</li> </ul>			•
		√	√		Silting of water bodies and dams contributes to sediment	<ul style="list-style-type: none"> <li>• Reduce siltation</li> </ul>			•



Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Ecosystem services					loads and turbidity which affect fishery and other aquatic ecosystem services.				
- Habitat service loss		√	√		Decrease existing water resource's functions and services (cleaning, drinking, etc)	<ul style="list-style-type: none"> <li>Reduce water pollution through good chemical management and watershed management</li> </ul>			•
- Impact on economic Service/supporting service		√	√		Existing vegetation resource's functions and services (medicinal, energy, etc)	<ul style="list-style-type: none"> <li>In situ and ex situ conservation for indigenous medicinal plants</li> </ul>			•
- Impacts on social Service/cultural services		√	√		Existing land resources functions and services (grazing land, communal land, forest land, etc)	<ul style="list-style-type: none"> <li>Prepare land use plan for optimized use of resources</li> </ul>			•
- etc		√	√		Habitats/ecosystems reserved for special interest such as conservation, scientific importance, recreational value, etc.,	<ul style="list-style-type: none"> <li>Preparation of Alternative recreational botanical garden</li> </ul>			•
		√	√		Habitats designated for wildlife conservation such as National Parks, Wildlife Sanctuaries, Wildlife Reserves and Controlled Hunting Areas	<ul style="list-style-type: none"> <li>Change the layout of canal systems</li> <li>Diversion site change</li> </ul>			•
		√	√		Loss of provision such as fresh water, genetic resources, timber, food, fuel and bio-products	<ul style="list-style-type: none"> <li>Nursery establishment</li> <li>Ex situ gene bank conservation</li> <li>Reforestation</li> </ul>			•
<b>Disaster Risks not limited to:</b>					.				
		√	√	√	Failure of irrigation dam, canals and other irrigation	<ul style="list-style-type: none"> <li>Proper stability checking of dam and periodical monitoring of dam status</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Flooding, disease, pests and disease infestations, land slide, etc					infrastructures may result in flood occurrences				
			√	√	Human and livestock disease epidemics	<ul style="list-style-type: none"> <li>• Avoid insect breeding sites</li> <li>• Avoid water ponding</li> <li>• Vaccination of animals and humans</li> </ul>			•
			√		Crop pests,	<ul style="list-style-type: none"> <li>• Use of pesticides</li> <li>• Use of improved pest resistant varieties</li> </ul>			•
		√	√		Earthquake related to irrigation dam	<ul style="list-style-type: none"> <li>• Use light weight construction materials</li> </ul>			•
		√	√	√	Land slide,	<ul style="list-style-type: none"> <li>• Avoid irrigation related gully and rill erosions</li> <li>• Avoid gorges</li> </ul>			•
<b>Contribution to Weather and Climate change</b>									
Change in atmospheric circulation			√	√	Irrigation has immediate effects on the provision of moisture to the atmosphere, inducing atmospheric instabilities and increasing downwind rainfall, or in other cases modifies the atmospheric circulation, delivering rain to different downwind areas.	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>			•
				√	Precipitation and Temperature change	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>			•
			√		Evaporation will increase due to irrigation activities and causes more water vapor (GHG)	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Green house gaseous (GHG) emission		√	√		Land Use Change due to irrigation is responsible for global greenhouse gas emissions, principally from deforestation which more related to greater temperature variations, decreased proportions of soil retention of carbon, and changes in precipitation Repetitive ploughing causes change in soil physicochemical properties that finally lead to more soil microbial respiration which releases GHG.	<ul style="list-style-type: none"> <li>Agroforestry</li> <li>Reduce repetitive ploughing</li> <li>Developing green belt</li> <li>Reduce use of excess industrial fertilizer</li> <li>Use of organic fertilizer</li> </ul>			•
			√		Water logging due to improper drainage of excess water will cause production of GHG (Methane) due to soil oxygen deficiency (anoxia)	<ul style="list-style-type: none"> <li>Avoid unnecessary use of water</li> <li>Proper drainage design</li> </ul>			•
<b>Impacts on Socio-economy</b>									
Change in population size	√	√	√		As irrigated agriculture demands much labor, influxes of migrant laborers were attracted from the surrounding area and boosted the laborers population size of the irrigation area	<ul style="list-style-type: none"> <li>Give priority on job opportunity to local youth</li> </ul>			•
Economy	√	√	√	√	Shift in way of life –from pastorals to farming practice – this may challenge the economy of the area especial	<ul style="list-style-type: none"> <li>Training and demonstration to the newly introduced technology</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					at initial stage the project practice due to lack of experience				
Women work load, absence from education and sexual harassment		√	√	√	Irrigation intentionally hires women for work which poses work load on them.	<ul style="list-style-type: none"> <li>Give equal chance to all</li> </ul>			•
	√	√	√		Absence from school due to engagement of women on irrigation project	<ul style="list-style-type: none"> <li>Work shift for the m to learn</li> <li>Reduce other workloads at home</li> </ul>			•
					Women may be exposed to sexual harassment	<ul style="list-style-type: none"> <li>Proper orientation for harassment protection</li> <li>Mainstreaming in gender issues in irrigation</li> </ul>			•
Displacement	√	√			Displacement of population from their land and home	<ul style="list-style-type: none"> <li>Compensation</li> </ul>			•
Land Acquisition and Loss of livelihood	√	√			The most adverse socioeconomic impacts of the irrigation project are the dispossession of farmland and displacement of farmers from their agricultural land and residences.	<ul style="list-style-type: none"> <li>Compensation</li> <li>Share holder</li> <li>Safety net program</li> </ul>			•
	√	√			Impacts on Housing Structures and Homesteads (Involuntary Resettlement)	<ul style="list-style-type: none"> <li>Compensation for house and homesteads</li> </ul>			•
Disruption of Social and Cultural Ties	√	√	√		A sense that they feel some discomfort and fear of the disruption of their social and cultural ties due to displacement.	<ul style="list-style-type: none"> <li>Reconstruct the social ties at the new location</li> </ul>			•
Impacts on Public, health, Community Institutions and infrastructures	√	√			Impact on social services and facilities like public buildings, schools, health facilities, water supply and	<ul style="list-style-type: none"> <li>Construction of new infrastructure for the destroyed once</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					religious institutions (churches and mosques), destruction of existing roads and a railway that extends at premises of the irrigation projects				
Social evils	√	√	√		Increased financial flow, social evils (Drug abuse, unwanted pregnancies and violence), boom and bust phenomenon associated with temporary labor contracts	<ul style="list-style-type: none"> <li>• Increase awareness of all workers and the surrounding community members on fighting social evils</li> </ul>			•
Increased level of disease vectors	√	√	√		Wastes disposed haphazardly form micro-environments for breeding of disease vectors. The crevices could provide habitats for mosquitoes, rats, cockroaches, flies.	<ul style="list-style-type: none"> <li>• Proper waste disposal and hierarchical waste management system</li> <li>• Avoid pest and mosquito breeding grounds</li> </ul>			•
Public health		√	√		Increased incidence of water-related disease such as diarrhea, malaria or sleeping sickness Risk of introduction of new diseases as schistosomiasis is	<ul style="list-style-type: none"> <li>• Avoid pest and mosquito breeding grounds</li> <li>• Spray chemicals</li> <li>• Vaccination</li> <li>• Water treatment</li> <li>• Optional water supply</li> <li>• Avoid water pollution</li> </ul>			•
		√	√		Communicable diseases Construction activities: in irrigation projects may pose labor to the project site which may bring communicable diseases (HIV/AIDS, COVID-19, etc)	<ul style="list-style-type: none"> <li>• Appropriate PPE provision</li> <li>• Provision of condoms</li> <li>• Training on STD and PPE to workers</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
Occupational health and safety		√	√		<b>Chemical Exposures/Poisonings</b> – Result in acute and/or long-term health hazards for personnel who handle chemicals, pollution or other products, or reduce such risks. Workers result in an increased or decreased risk that chemicals are unintentionally spread, by air, water or via food chains, through the use of chemicals, or through poor storage conditions or inadequate facilities for the destruction of waste products	<ul style="list-style-type: none"> <li>• PPE provision</li> <li>• Care in use and opening</li> <li>• Use instruction properly</li> <li>• Training on use of PPE to workers</li> </ul>			•
		√	√		<b>Dust and other particulate matter</b> - land preparation cause dust re-suspension and vehicles and machineries release dust and particulate matter that health effect on lung function	<ul style="list-style-type: none"> <li>• Appropriate PPE provision</li> <li>• Training on use of PPE to workers</li> <li>• Watering to minimize dust re-suspension</li> </ul>			•
		√	√		<b>Machinery and working equipments</b> -Mobile machines such as tractors, front-end loaders, skid-steers, material handlers and forklifts are often used inside and outside agricultural installations for production, daily chores or intermittent maintenance	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision</li> <li>• Training on use of PPE to workers</li> <li>• Provide safety signs and warnings</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					activities. Machines used in agricultural installations may also use buckets, forks or blades for handling manure, feed or other materials. Hazards for these activities may include being crushed by falling objects or materials from buckets and lifts, run-over of co-workers or bystanders, machines slipping off the edges of ramps or building drop-offs				
		√	√	√	<b>Electrical Contacts and Fire explosion</b> Overhead power line contacts, short circuits, working on energized equipment, lightning strikes	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision</li> <li>• Training on use of PPE to workers</li> <li>• Provide warning signs</li> </ul>			•
		√	√		<b>Contact/Entanglement with Moving Parts</b> -due to the mechanical nature of lifting, pressurizing and transporting water, irrigation pumping plants universally consist of rotating parts. Common rotating components include belt drives, drive shafts, fan blades, pump vanes, right-angle drives, motors, etc	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision</li> <li>• Training on use of PPE to workers</li> <li>• Provide warning signs</li> <li>• Unsure availability of material data sheet to the workers</li> </ul>			•
		√	√		<b>Falls from height</b> - workers fall from ladder and when working at a height	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision (Hemate)</li> <li>• Provide warning signs</li> <li>• Training on use of PPE to workers</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
		√	√		<b>Drowning - rivers, lakes, canals, ponds, pits, etc.</b>	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision (Hemate)</li> <li>• Provide /ensure warning signs</li> <li>• Training on use of PPE to workers</li> </ul>			•
		√	√		<b>Physical Damage (Head, Eye, Ear, Hand &amp; Foot)</b>	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision (Hemate)</li> <li>• Provide/ensure warning signs</li> <li>• Training on use of PPE to workers</li> </ul>			•
		√	√		<b>Ergonomics and heading of materials:</b> Ergonomic factors affect the health outcomes of irrigation workers includes:– the nature of the physical work environment (noise, heat, lighting, thermal comfort), the agricultural tasks to be performed; – the technology applied to the prescribed tasks (including workplace design, facility design, and agricultural material handling); – the manner in which tasks are organized (including use of shift work); and – worker characteristics (including demographics, physiology, human error, and identification and treatment of injured workers).	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision (Hemate)</li> <li>• Provide signs</li> <li>• Training on use of PPE to workers</li> </ul>			•
		√	√		<b>Vibration-</b> vibration of machinery and vehicles	<ul style="list-style-type: none"> <li>• Ensure appropriate PPE provision (Hemate)</li> <li>• Provide/ensure warning signs</li> </ul>			•



Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
						<ul style="list-style-type: none"> <li>• Training on use of PPE to workers</li> </ul>			
			√		<b>Waste-</b> workers exposed to both liquid and solid wastes from irrigation	<ul style="list-style-type: none"> <li>• Proper waste management</li> <li>• Ensure appropriate PPE provision (Hemate)</li> <li>•</li> </ul>			•
			√	√	<b>Injury from wild animals</b> – Insects, snakes bites	<ul style="list-style-type: none"> <li>• Prepare sufficient first aid</li> <li>• Prepare health services</li> <li>• Clear sites</li> </ul>			•
		√	√		<b>Noise exposure</b> – machines and vehicles produce noise that can affect the hearing of the workers and permanent damage to ears	<ul style="list-style-type: none"> <li>• PPE provision (Ear plugs)</li> <li>• Grease and service machineries and vehicles</li> <li>• Regular service to equipments</li> </ul>			•
		√	√		<b>Confined space-</b> Entry into confined spaces can pose very serious risks for workers, including suffocation and drowning	<ul style="list-style-type: none"> <li>• Sufficient ventilation of workplace</li> <li>• Training of workers</li> </ul>			•
	√	√	√		<b>Traffic accident, fall collision during transportation of material and agricultural product</b> - Agricultural workers use a variety of vehicles for transportation, including buses, trucks, trailers, automobiles, all-terrain vehicles, bicycles and agricultural equipment. Operators and passengers can fall while mounting or dismounting. They can fall within or from vehicles	<ul style="list-style-type: none"> <li>• Place rules in control of speed limits</li> <li>• Control speed limits of vehicles around the project sites</li> <li>• Prepare proper Parking area</li> <li>• Aware drivers for their speed limits</li> </ul>			•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					during transport. They can be injured by contact with interior paneling or fixtures, other persons, or objects during unexpected stops and starts or in a turnover or collision. Often oxen, donkeys, mules, etc., are often used as a means of transport of people, equipment and goods.				
		√	√		<b>Exposure to bad weather /climate</b> – irrigation is mostly practiced at outdoor at very hot and cold climate conditions	<ul style="list-style-type: none"> <li>• Proper cooling and ventilation of work places in dessert areas</li> <li>• Proper heating of the work place in cold areas</li> <li>• Evacuation plan preparation</li> </ul>			•
Loss of jobs				√	After decommission the employers might loss job	<ul style="list-style-type: none"> <li>• Create alternative job opportunity to the workers</li> </ul>			•
Life cycle impact	√	√	√	√	The product life cycle impact on the environment (packing material nature; specially lack of biodegradability)	<ul style="list-style-type: none"> <li>• Use of biodegradable materials in the life cycles of the project</li> </ul>			•
<b>Complaints /grievances and Conflicts</b>	√ √ √	√ √ √	√ √ √		Grievances resulting from incompatibility to the local culture, competition over employment, loss of control / income of land, flood from irrigation project	<ul style="list-style-type: none"> <li>• Training of the proponents to respect the local culture and norms</li> <li>• Establish conflict resolution committee</li> <li>• Conflict resolution document preparation</li> </ul>			•
					Labour issues are always a source of friction between companies and communities and also among community members.	<ul style="list-style-type: none"> <li>• Workers and employers participation in conflict resolution</li> <li>• Share job opportunity</li> <li>• Teach about the project/teach /train</li> </ul>			

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Institutional Responsibilities	When to implement? (schedule of mitigation plan implementation)	Cost Estimates
					When problem is not solved timely and the risk level for the project may dramatically increase	on procedures to be followed			
					Communities/stakeholders and project affected person may turn to protest and conflict which needs Grievances redress mechanisms				

**Table 23: Environmental and Social impacts monitoring plan format**

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
<b>Beneficial impacts</b>													
Increased incomes and income base,	√	√	√	√	Increased crop productivity and food security and break the cycle of poverty	<ul style="list-style-type: none"> <li>Give preference to local employment (men and women) and local inputs (food,</li> </ul>							

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
Food availability and Poverty reduction						<p>basic material) to the extent possible.</p> <ul style="list-style-type: none"> <li>• Ensure that revenues generated by crop production activities are sufficient to cover the cost of irrigation infrastructures construction and maintenance.</li> <li>• Base profitability projections on conservative revenue assumptions.</li> <li>• Whenever possible, give priority access to irrigated schemes to men and women who are losing productive means (owners and people cultivating the land).</li> <li>• Ensure that compensations cover all revenue and asset losses by adversely affected men and women, either if they are landowners or land users.</li> <li>• Identify why specific groups are not</li> </ul>							

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates	
						<p>benefiting from the project and adopt corrective measures as required, such as favouring excluded groups when irrigated schemes are reallocated or expanded.</p> <ul style="list-style-type: none"> <li>• Ensure that women are directly paid for their work, avoiding intermediaries.</li> <li>• Ensure that not only land owners but also women and men occupying / cultivating the land are compensated for the losses related to the project.</li> <li>• Ensure that project promoters do not reinforce cultural barriers affecting negatively women</li> <li>• Consider targeting women beneficiaries when inequities exist and persist.</li> </ul>								

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Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
					cropping patterns, and to switch from low value staple production to high-value market-oriented production. Increased production makes food available and affordable for the poor by increasing purchasing power	oriented production systems							
Import substitution			√		The country is spending relatively huge amount of money for imports of various products which can be replaced by production	<ul style="list-style-type: none"> <li>Awareness creation, incentive provision, market linkage, media coverage for use of locally produced irrigation products as a substitute for imported products</li> </ul>	•	•	•	•	•	•	•
Promotion of export and generation of foreign exchange			√		Increases the foreign exchange by promoting export based production	<ul style="list-style-type: none"> <li>Awareness of creation and incentive provision export production systems</li> <li>Foreign market linkage creation</li> <li>Easy logistic services</li> </ul>	•	•	•	•	•	•	•
Improve quality of life			√		Improving the quality and living standards of citizens	<ul style="list-style-type: none"> <li>Increase irrigation sustainability by reducing postharvest losses, providing irrigation and postharvest technologies, etc</li> </ul>	•	•	•	•	•	•	•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
GDP			√		Increment in the Gross Domestic Product	<ul style="list-style-type: none"> <li>Awareness in taxpaying and tax collecting system</li> <li>Ease tax paying system</li> </ul>	•	•	•	•	•	•	•
Creation of eco-friendly environment and better microclimate			√		<p>Development of conveniences and large scale green parks along existing streams and canals will be established which will make the place more pleasant and attractive for workers and communities</p> <p>Creation of a better microclimate in the irrigation project area, due to development of green belt around the irrigation project area</p>	<ul style="list-style-type: none"> <li>Awareness creation in greening programs and waste management system</li> <li>Provide place for Nursery establishment</li> </ul>	•	•	•	•	•	•	•
Increment in employment	√	√	√	√	Because of the labor intensive nature of irrigation huge employment opportunity created for people around and beyond the irrigation project area	<ul style="list-style-type: none"> <li>Give preference to local employment (men and women) and local inputs (food, basic material) to the extent possible.</li> </ul>	•	•	•	•	•	•	•



Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
Access to infrastructures and services					<p>Establishment a transport link related to irrigation project which may include all weather roads and a railway that may extend into the premises of the irrigation projects giving easy access for import and export of goods for local community</p> <p>Development of Health Post or Clinic in any of the near the irrigation project area which can provide from low level to medium level of health services</p> <p>Construction of religious sites</p> <p>Construction of Water Supply and Sanitation</p> <p>Development of modern communication systems such as telephone lines, internet, satellite television, and short-range radio communications</p> <p>irrigation to the irrigation project.</p>	<ul style="list-style-type: none"> <li>During project preparation, consult concerned ministries to verify the adequacy of current and proposed social infrastructures.</li> <li>Involve users, men and women, in the maintenance and management of new infrastructures to ensure their sustainability.</li> <li>Ensure appropriate social services are available to address the basic needs of the host and migrant populations.</li> <li>Assist social service administrations in coordinating their efforts to offer additional services and improve service delivery, if required.</li> <li>Implement consumption fees on irrigation water to finance infrastructure construction and maintenance.</li> <li>Promote safety net measures to protect the poor and other vulnerable groups against price increases in social services.</li> <li>Awareness to the investor for its corporate social responsibility</li> </ul>							

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
					The population of the irrigation project area is being served by the nearest fuel stations, postal office, a bank, court and police station services that may develop in the immediate vicinity of the irrigation project.								
Skill transfer, capacity building and technology transfer	√	√	√	√	Skill transfer, capacity building and technology transfer in irrigation	<ul style="list-style-type: none"> <li>Enhancement of skill transfer, capacity building and technology transfer through provision of practical training and demonstration</li> <li>Prepare farmers field day</li> </ul>	•	•	•	•	•	•	•
Enhancement of market and investment project area	√	√	√		Boost micro-investment in the project area	<ul style="list-style-type: none"> <li>Training on better service provision</li> <li>Information provision for consumers of irrigation products</li> </ul>	•	•	•	•	•	•	•
Experience sharing in Environmental management			√	√	Watershed management. Water quality, Water use increase	<ul style="list-style-type: none"> <li>Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform</li> </ul>	•	•	•	•	•	•	•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
	✓	✓	✓	✓	Protection of vegetation habitats and specific ecosystems	• Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform	•	•	•	•	•	•	•
		✓	✓	✓	Water access and rights, Land uses, Natural resources management and Agricultural practices	• Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform	•	•	•	•	•	•	•
			✓	✓	Sanitation and hygienic conditions	• Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform	•	•	•	•	•	•	•
			✓	✓	Food supply and safe drinking water	• Experience sharing facilities like communication facilities, place, establishment of stakeholders participation platform	•	•	•	•	•	•	•
Gender	✓	✓	✓	✓	Reduce women's workload, Control over land and land proceeds, Income-generating	• Promote women and children with means to reduce the efforts required for water	•	•	•	•	•	•	•

Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
					activities, Access to facilities and services and Women's involvement in decision-making processes	transportation (donkey, cart, etc.). • Plan for the expansion of drinking water supply sources and for their location close to human settlements while planning an irrigation project. • Plan support initiatives to reduce women's reproductive workload.							
<b>Adverse impacts</b>					<b>Detail impacts</b>	<b>Mitigation measures</b>							
<b>Physicochemical impacts</b>													
Land use change	√	√			Existing pastoral farmers or bushes, forest changed to irrigation land and these could be linked to adverse impact on soil erosion, precipitation and hydrological impacts	• Increase awareness of the community for the erosion free grazing, avoid unwanted deforestation, rehabilitation afforestation of degraded communal lands, area closure, etc	•	•	•	•	•	•	•
			√	√	<b>Soil compaction and salinization:</b> Agricultural land takes nutrient leaving salt in the soil. Similarly	• Irrigation technology improvement (Drip) • Leaching the salts	•	•	•	•	•	•	•



Expected impact	PCP	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
						<ul style="list-style-type: none"> <li>Maintain vegetation hedges in order to reduce wind erosion.</li> </ul>							
			√	√	<b>Alkalization:</b> by an increase in the concentration of Na <sup>+</sup> + K <sup>+</sup> , HCO <sub>3</sub> <sup>-</sup> , and TDS in soil	<ul style="list-style-type: none"> <li>Irrigation technology improvement (Drip)</li> <li>Leaching the salts</li> <li>Minimize use of inorganic fertilizer</li> <li>Avoid use of salty water</li> </ul>	•	•	•	•	•	•	•
		√	√	√	<b>Water logging:</b> It occurs when there is too much water in a plant's root zone, which decreases the oxygen available to roots. Water logging results primarily from inadequate drainage and over-irrigation and, to a lesser extent, from seepage from canals and ditches	<ul style="list-style-type: none"> <li>In order to avoid water saturation, regulate adequately the irrigation (avoid excessive irrigation), maintain the drainage network and select an irrigation system that is low demanding in water and appropriate for crops.</li> </ul>	•	•	•	•	•	•	•
			√	√	<b>Soil acidification:</b> Soil acidification occurs because the concentration of hydrogen ions in the soil increases, Ammonium-based fertilizers are the major contributors to soil acidification, especially if the nitrogen is leached	<ul style="list-style-type: none"> <li>Irrigation technology improvement (Drip)</li> <li>Leaching the salts using clean water</li> <li>Minimize use of inorganic fertilizer</li> <li>Use of lime treatment and bio char</li> </ul>	•	•	•	•	•	•	•

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					rather than taken up by plants, Ammonium nitrogen from fertilizer or soil organic matter is readily converted to nitrate and hydrogen ions by bacteria in the soil. Removal of plant and animal products leaching of excess nitrate								
		√	√	√	<b>Loss of soil fertility:</b> All crop residue and green byproducts are removed from the field for livestock feed, fuel and house construction, Nutrients are removed more rapidly than they are replaced Furrow & flood irrigation along the slope leads to soil loss and nutrient depletion	<ul style="list-style-type: none"> <li>• Use residues of the crop for self-mulching</li> <li>• Use compost</li> <li>• Use improved irrigation methods (Drip)</li> <li>• Reduce frequency of irrigation</li> <li>• Use of SWC structural measures</li> <li>• Prepare proper drainage</li> </ul>	•	•	•	•	•	•	•
Water consumption, impact on Water availability and Water pollution			√	√	<b>Water quality problems for downstream:</b> Drainage of surface and groundwater in the irrigation project area, which waters may be salinized and polluted by agricultural chemicals like biocides and	<ul style="list-style-type: none"> <li>• Maintain vehicles, machinery and equipment in good condition in order to avoid leaks and spill of hazardous materials.</li> <li>• Take all precautions during the refuelling</li> </ul>	•	•	•	•	•	•	•

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					fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for industrial, municipal and household use, Use of waste water for irrigation	of vehicles, machinery and pumps, and forbid the refuelling near water bodies. <ul style="list-style-type: none"> <li>• Ensure a safe management of hazardous materials.</li> <li>• Avoid crossing permanent waterways; if necessary, locate the crossing where the banks are stable and the narrowest.</li> <li>• Do not hamper drainage of surface water and plan for restoration measures after construction.</li> <li>• Plan works in areas prone to flooding outside the rainy season.</li> <li>• Install appropriate sanitary facilities in workers' camps.</li> <li>• Adopt a watershed management approach while designing the project.</li> </ul>							



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						<ul style="list-style-type: none"><li>Minimise the loss of water caused by leaks, evaporation and infiltration through canals and reservoirs (e.g. maintain vegetation along water canals).</li><li>Develop compensation measures for affected downstream water users.</li><li>Ensure that drainage water complies with discharge standards, treat wastewater accordingly and ensure safe re-use of wastewater.</li><li>Design water canals for reducing sedimentation and facilitating drainage and maintenance.</li><li>Control access to irrigation water for other purposes than irrigation (safety measures and rules).</li><li>Remove aquatic vegetation from</li></ul>							

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						<ul style="list-style-type: none"> <li>margins of water canals and reservoirs.</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>							
		√	√		<b>Shortage of water availability especially for downstream community:</b> users caused by irrigation return flow quality-cause an increase or decrease in the availability of surface water or ground water, locally or regionally	<ul style="list-style-type: none"> <li>Alternative water sources provision for downstream users</li> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Ground and surface water depletion:</b> An irrigation scheme draws water from groundwater, rivers, lakes or overland flow, there for withdrawn for irrigation	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> </ul>	•	•	•	•	•	•	•

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					has impacts on rivers , lakes and ground water reduction	<ul style="list-style-type: none"> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>							
			√	√	<b>Dry drinking &amp; irrigation well:</b> Some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system maintenance by establishing fees for water users.</li> </ul>	•	•	•	•	•	•	•
			√		<b>Reduced base flow / wetlands:</b> If they exceed the natural recharge rates of the aquifers concerned, can lower water tables and thereby reduce flows into wetlands and rivers	<ul style="list-style-type: none"> <li>Adjust the annual pumped water volumes in accordance with the aquifer annual refill.</li> <li>Watershed management</li> <li>Ensure proper water management and irrigation system</li> </ul>	•	•	•	•	•	•	•

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						maintenance by establishing fees for water users.							
			√	√	<b>Agrochemical pollution:</b> Nonpoint source pollution, unlike pollution from point sources such as industrial and sewage treatment plants, comes from many diffuse sources of irrigation project(s), etc	<ul style="list-style-type: none"> <li>Avoid use of excessive industrial fertilizer</li> <li>Minimize use of pesticide and herbicides</li> <li>Use bioremediation</li> </ul>	•	•	•	•	•	•	•
Siltation		√	√		Silting of canals, water bodies and dams contributes to sediment loads and turbidity which affect fish and other aquatic organisms	<ul style="list-style-type: none"> <li>Watershed management</li> <li>Fitting of screens at the inlet from diversions to canals</li> <li>Delineate buffer zone for water bodies</li> </ul>	•	•	•	•	•	•	•
<b>Biological impacts</b>													
Forest and bush clearance	√	√	√		Loss of habitat for animals, and conversion of biodiversity rich natural and semi natural habitats to crop production (to irrigation project)	<ul style="list-style-type: none"> <li>Delineate buffer zone in irrigation side which serve wild life and animals</li> </ul>	•	•	•	•	•	•	•
			√	√	Bush encroachment and bush fires resulting from selective grazing	<ul style="list-style-type: none"> <li>Use cut and carry system</li> <li>Area closure</li> </ul>	•	•	•	•	•	•	•

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	√	√	√		Changes to the structure and botanical composition or natural vegetation which are not necessarily negative	<ul style="list-style-type: none"> <li>Afforestation of diversified forest varieties</li> <li>Manage sensitive and endangered species</li> <li>In situ or ex situ conservation</li> <li>Reduce cutting of indigenous trees</li> <li>Apply agroforestry</li> </ul>	•	•	•	•	•	•	•
		√	√		Loss in pasture land	<ul style="list-style-type: none"> <li>Use cut and carry system</li> <li>Area closure</li> </ul>	•	•	•	•	•	•	•
		√	√		Overuse of the vegetation combined with excessive trampling leads to soil compaction and reduction in plant cover								
		√	√		Degradation of rangelands due to livestock diversification,	<ul style="list-style-type: none"> <li>Use cut and carry system</li> <li>Area closure</li> <li>Forage plantation</li> </ul>	•	•	•	•	•	•	•
		√	√		Excessive use of resource if animal numbers allowed building up (ie. Not consumed locally or marketed)	<ul style="list-style-type: none"> <li>Use cut and carry system</li> <li>Forage plantation</li> </ul>	•	•	•	•	•	•	•
Poisoning of grazing land		√	√		Poisoning of animals grazing the area where pesticides is pumped, dripped off treated	<ul style="list-style-type: none"> <li>Avoid spilling of agrochemicals in grazing land</li> </ul>	•	•	•	•	•	•	•

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					livestock or deposited by spray from a spray race	<ul style="list-style-type: none"> <li>Good management of machinery oils and greases</li> </ul>							
Prevalence of disease causing microorganisms and insects			√		Increase in prevalence of malaria due to construction of livestock watering points	<ul style="list-style-type: none"> <li>Clean and avoid insect breeding sites</li> <li>Spray chemicals</li> </ul>	•	•	•	•	•	•	•
			√		Increase in tsetsefly population	<ul style="list-style-type: none"> <li>Clean and avoid insect breeding sites</li> <li>Spray chemicals</li> </ul>	•	•	•	•	•	•	•
Fisheries, Amphibians and Reptiles			√		Aquatic and wetland species may suffer as a result of the drying out of wetlands, or lowered flow and increased temperature in rivers, as a result of abstraction for irrigation	<ul style="list-style-type: none"> <li>Use of alternative water resources</li> <li>Establishment of buffer zone</li> <li>Good management of agro-chemicals</li> </ul>	•	•	•	•	•	•	•
Birds in the project area			√		Migration of birds, decline in population of birds related to habitat decline and habitat modification	<ul style="list-style-type: none"> <li>Minimize unnecessary bird site destruction</li> <li>Avoid unnecessary chemical release</li> </ul>	•	•	•	•	•	•	•
					Toxicity to birds, which ingest poisoned ticks								
Soil Microorganisms (Fungi, Bacteria and Actinomyces)			√		Various chemicals and nutrients used have adverse impacts on soil and aquatic microorganism and on their interaction	<ul style="list-style-type: none"> <li>Avoid use of heavy machinery operations</li> <li>Use of organic fertilizers</li> <li>Avoid use of unnecessary</li> </ul>	•	•	•	•	•	•	•

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						chemicals • Use of soil reclaiming seed varieties • Reduce erosion							
<b>Impacts on Ecological, Ecosystem function and services not limited to:</b>													
Biodiversity loss and risks		√	√		Reduced bio-diversity	<ul style="list-style-type: none"> <li>Afforestation of diversified forest varieties</li> <li>Manage sensitive and endangered species</li> <li>In situ or ex situ conservation</li> <li>Reduce cutting of indigenous trees</li> <li>Apply agroforestry</li> </ul>	•	•	•	•	•	•	•
		√	√		Migration and decrease in fish productivity	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation</li> </ul>	•	•	•	•	•	•	•
		√	√		Changes in primary productivity due to	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers</li> </ul>	•	•	•	•	•	•	•

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					biochemical reactions	that causes eutrophication <ul style="list-style-type: none"> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation</li> </ul>							
		√	√		Risk of eutrophication / growth of non-native and/or invasive species	<ul style="list-style-type: none"> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Reduce siltation</li> </ul>	•	•	•	•	•	•	•
		√	√		Opportunistic growth of aquatic macrophytes in the littoral and sub-littoral zone of the aquatic environment	<ul style="list-style-type: none"> <li>Reduce siltation</li> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Avoid excess water abstraction</li> <li>Good weed management</li> </ul>	•	•	•	•	•	•	•
		√	√		Irrigation can also bring new risks beyond the farm scale, for example as related to crop disease and diversity as demand	<ul style="list-style-type: none"> <li>Conservation of traditional varieties</li> <li>Use of scientifically approved and locally adaptable seed variety</li> </ul>	•	•	•	•	•	•	•



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					for traditional varieties decline	<ul style="list-style-type: none"> <li>On time spray and weeding</li> </ul>							
Ecological function			√	√	Adverse impacts on ecological function such as carbon storage, nutrient cycling, water air purification, diseases regulation, Soil formation, primary production and pollination	<ul style="list-style-type: none"> <li>Increasing carbon sequestration capacity through organic fertilizer application</li> <li>Avoid repetitive ploughing if possible</li> <li>Avoid excess use of nitrogen Fertilizers that causes eutrophication</li> <li>Avoid spill of agrochemicals to water bodies</li> <li>Avoid excess water abstraction</li> <li>Good weed management</li> </ul>	•	•	•	•	•	•	•
Ecosystem services		√	√		Silting of water bodies and dams contributes to sediment loads and turbidity which affect fishery and other aquatic ecosystem services.	<ul style="list-style-type: none"> <li>Reduce siltation</li> </ul>	•	•	•	•	•	•	•
<ul style="list-style-type: none"> <li>Habitat service loss</li> <li>Impact on econom</li> </ul>		√	√		Decrease existing water resource's functions and services (cleaning, drinking, etc)	<ul style="list-style-type: none"> <li>Reduce water pollution through good chemical management and watershed management</li> </ul>	•	•	•	•	•	•	•

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ic Service/ supporting service - Impacts on social Service/ cultural services - etc		√	√		Existing vegetation resource's functions and services (medicinal, energy, etc)	<ul style="list-style-type: none"> <li>In situ and ex situ conservation for indigenous medicinal plants</li> </ul>	•	•	•	•	•	•	•
		√	√		Existing land resource's functions and services (grazing land, communal land, forest land, etc)	<ul style="list-style-type: none"> <li>Prepare land use plan for optimized use of resources</li> </ul>	•	•	•	•	•	•	•
		√	√		Habitats/ecosystems reserved for special interest such as conservation, scientific importance, recreational value, etc.,	<ul style="list-style-type: none"> <li>Preparation of Alternative recreational botanical garden</li> </ul>	•	•	•	•	•	•	•
		√	√		Habitats designated for wildlife conservation such as National Parks, Wildlife Sanctuaries, Wildlife Reserves and Controlled Hunting Areas	<ul style="list-style-type: none"> <li>Change the layout of canal systems</li> <li>Diversion site change</li> </ul>	•	•	•	•	•	•	•
		√	√		Loss of provision such as fresh water, genetic resources, timber, food, fuel and bio-products	<ul style="list-style-type: none"> <li>Nursery establishment</li> <li>Ex situ gene bank conservation</li> <li>Reforestation</li> </ul>	•	•	•	•	•	•	•
<b>Disaster Risks not limited to:</b>					.								
Flooding, disease, pests and disease		√	√	√	Failure of irrigation dam, canals and other irrigation infrastructures may result in flood occurrences	<ul style="list-style-type: none"> <li>Proper stability checking of dam and periodical monitoring of dam status</li> </ul>	•	•	•	•	•	•	•

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infestations, land slide, etc			√	√	Human and livestock disease epidemics	<ul style="list-style-type: none"> <li>Avoid insect breeding sites</li> <li>Avoid water ponding</li> <li>Vaccination of animals and humans</li> </ul>	•	•	•	•	•	•	•
			√		Crop pests,	<ul style="list-style-type: none"> <li>Use of pesticides</li> <li>Use of improved pest resistant varieties</li> </ul>	•	•	•	•	•	•	•
		√	√		Earthquake related to irrigation dam	<ul style="list-style-type: none"> <li>Use light weight construction materials</li> </ul>	•	•	•	•	•	•	•
		√	√	√	Land slide,	<ul style="list-style-type: none"> <li>Avoid irrigation related gully and rill erosions</li> <li>Avoid gorges</li> </ul>	•	•	•	•	•	•	•
<b>Contribution to Weather and Climate change</b>													
Change in atmospheric circulation			√	√	Irrigation has immediate effects on the provision of moisture to the atmosphere, inducing atmospheric instabilities and increasing downwind rainfall, or in other cases modifies the atmospheric circulation, delivering rain to different downwind areas.	<ul style="list-style-type: none"> <li>Reduce use of excess watering</li> <li>Flood control mechanisms</li> <li>Wind breaks and hedge rows</li> </ul>	•	•	•	•	•	•	•

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				✓	Precipitation and Temperature change	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>	•	•	•	•	•	•	•
			✓		Evaporation will increase due to irrigation activities and causes more water vapor (GHG)	<ul style="list-style-type: none"> <li>• Reduce use of excess watering</li> <li>• Flood control mechanisms</li> <li>• Wind breaks and hedge rows</li> </ul>	•	•	•	•	•	•	•
Green house gaseous (GHG) emission		✓	✓		Land Use Change due to irrigation is responsible for global greenhouse gas emissions, principally from deforestation which more related to greater temperature variations, decreased proportions of soil retention of carbon, and changes in precipitation Repetitive ploughing causes change in soil physicochemical properties that finally leads to more soil microbial respiration which releases GHG.	<ul style="list-style-type: none"> <li>• Agroforestry</li> <li>• Reduce repetitive ploughing</li> <li>• Developing green belt</li> <li>• Reduce use of excess industrial fertilizer</li> <li>• Use of organic fertilizer</li> </ul>	•	•	•	•	•	•	•
			✓		Water logging due to improper drainage of	<ul style="list-style-type: none"> <li>• Avoid unnecessary</li> </ul>	•	•	•	•	•	•	•

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					excess water will cause production of GHG (Methane) due to soil oxygen deficiency (anoxia)	• use of water • Proper drainage design							
<b>Impacts on Socio-economy</b>													
Change in population size	√	√	√		As irrigated agriculture demands much labor, influxes of migrant laborers were attracted from the surrounding area and boosted the laborers population size of the irrigation area	• Give priority on job opportunity to local youth	•	•	•	•	•	•	•
Economy	√	√	√	√	Shift in way of life – from pastorals to farming practice – this may challenge the economy of the area especial at initial stage the project practice due to lack of experience	• Training and demonstration to the newly introduced technology	•	•	•	•	•	•	•
Women work load, absence from education and sexual harassment		√	√	√	Irrigation intentionally hires women for work which poses work load on them.	• Give equal chance to all	•	•	•	•	•	•	•
	√	√	√		Absence from school due to engagement of women on irrigation project	• Work shift for the m to learn • Reduce other workloads at home	•	•	•	•	•	•	•

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					Women may be exposed to sexual harassment	<ul style="list-style-type: none"> <li>Proper orientation for harassment protection</li> <li>Mainstreaming in gender issues in irrigation</li> </ul>	•	•	•	•	•	•	•
Displacement	√	√			Displacement of population from their land and home	<ul style="list-style-type: none"> <li>Compensation</li> </ul>	•	•	•	•	•	•	•
Land Acquisition and Loss of livelihood	√	√			The most adverse socioeconomic impacts of the irrigation project are the dispossession of farmland and displacement of farmers from their agricultural land and residences.	<ul style="list-style-type: none"> <li>Compensation</li> <li>Share holder</li> <li>Safety net program</li> </ul>	•	•	•	•	•	•	•
	√	√			Impacts on Housing Structures and Homesteads (Involuntary Resettlement)	<ul style="list-style-type: none"> <li>Compensation for house and homesteads</li> </ul>	•	•	•	•	•	•	•
Disruption of Social and Cultural Ties	√	√	√		A sense that they feel some discomfort and fear of the disruption of their social and cultural ties due to displacement.	<ul style="list-style-type: none"> <li>Reconstruct the social ties at the new location</li> </ul>	•	•	•	•	•	•	•
Impacts on Public, health, Community Institutions and	√	√			Impact on social services and facilities like public buildings, schools, health facilities, water supply and religious institutions (churches and mosques), destruction of existing	<ul style="list-style-type: none"> <li>Construction of new infrastructure for the destroyed once</li> </ul>	•	•	•	•	•	•	•

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infrastructures					roads and a railway that extends at premises of the irrigation projects								
Social evils	√	√	√		Increased financial flow, social evils (Drug abuse, unwanted pregnancies and violence), boom and bust phenomenon associated with temporary labor contracts	<ul style="list-style-type: none"> <li>• Increase awareness of all workers and the surrounding community members on fighting social evils</li> </ul>	•	•	•	•	•	•	•
Increased level of disease vectors	√	√	√		Wastes disposed haphazardly form micro-environments for breeding of disease vectors. The crevices could provide habitats for mosquitoes, rats, cockroaches, flies.	<ul style="list-style-type: none"> <li>• Proper waste disposal and hierarchical waste management</li> <li>• Avoid pest and mosquito breeding grounds</li> </ul>	•	•	•	•	•	•	•
Public health		√	√		Increased incidence of water-related disease such as diarrhea, malaria or sleeping sickness Risk of introduction of new diseases as schistosomiasis	<ul style="list-style-type: none"> <li>• Avoid pest and mosquito breeding grounds</li> <li>• Spray chemicals</li> <li>• Vaccination</li> <li>• Water treatment</li> <li>• Optional water supply</li> <li>• Avoid water pollution</li> </ul>	•	•	•	•	•	•	•
		√	√		Communicable diseases Construction activities: in irrigation projects may pose labor to the project site which may bring	<ul style="list-style-type: none"> <li>• PPE provision</li> <li>• Provision of condoms</li> <li>• Training on STD to workers</li> </ul>	•	•	•	•	•	•	•

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					communicable diseases (HIV/AIDS, COVID-19, etc.)								
Occupational health and safety		√	√		<b>Chemical Exposures/Poisonings</b> – Result in acute and/or long-term health hazards for personnel who handle chemicals, pollution or other products, or reduce such risks. Workers result in an increased or decreased risk that chemicals are unintentionally spread, by air, water or via food chains, through the use of chemicals, or through poor storage conditions or inadequate facilities for the destruction of waste products	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Care in use and opening</li> <li>Use instruction properly</li> <li>Training on use of PPE to workers</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Dust and other particulate matter</b> - land preparation cause dust re-suspension and vehicles and machineries release dust and particulate matter that health effect on lung function	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Training on use of PPE to workers</li> <li>Watering</li> </ul>	•	•	•	•	•	•	•



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		√	√		<b>Machinery and working equipment</b> -Mobile machines such as tractors, front-end loaders, skid-steers, material handlers and forklifts are often used inside and outside agricultural installations for production, daily chores or intermittent maintenance activities. Machines used in agricultural installations may also use buckets, forks or blades for handling manure, feed or other materials. Hazards for these activities may include being crushed by falling objects or materials from buckets and lifts, run-over of co-workers or bystanders, machines slipping off the edges of ramps or building drop-offs	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Training on use of PPE to workers</li> <li>Provide signs</li> </ul>	•	•	•	•	•	•	•
		√	√	√	<b>Electrical Contacts and Fire explosion</b> Overhead power line contacts, short circuits, working on energized	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Training on use of PPE to workers</li> <li>Provide signs</li> </ul>	•	•	•	•	•	•	•

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					equipment, lightning strikes								
		√	√		<b>Contact/Entanglement with Moving Parts</b> -due to the mechanical nature of lifting, pressurizing and transporting water, irrigation pumping plants universally consist of rotating parts. Common rotating components include belt drives, drive shafts, fan blades, pump vanes, right-angle drives, motors, etc.	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Training on use of PPE to workers</li> <li>Provide signs</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Falls from height</b> -workers fall from ladder and when working at a height	<ul style="list-style-type: none"> <li>PPE provision (Hemate)</li> <li>Provide signs</li> <li>Training on use of PPE to workers</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Drowning - rivers, lakes, canals, ponds, pits, etc.</b>	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Provide signs</li> <li>Training on use of PPE to workers</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Physical Damage (Head, Eye, Ear, Hand &amp; Foot)</b>	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Provide signs</li> <li>Training on use of PPE to workers</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Ergonomics and heading of materials:</b> Ergonomic factors affect	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Provide signs</li> <li>Training on use of</li> </ul>	•	•	•	•	•	•	•

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					the health outcomes of irrigation workers includes:– the nature of the physical work environment (noise, heat, lighting, thermal comfort), the agricultural tasks to be performed; – the technology applied to the prescribed tasks (including workplace design, facility design, and agricultural material handling); – the manner in which tasks are organized (including use of shift work); and – worker characteristics (including demographics, physiology, human error, and identification and treatment of injured workers).	PPE to workers							
		√	√		<b>Vibration-</b> vibration of machinery and vehicles	<ul style="list-style-type: none"> <li>PPE provision</li> <li>Provide signs</li> <li>Training on use of PPE to workers</li> </ul>	•	•	•	•	•	•	•
			√		<b>Waste-</b> workers exposed to both liquid and solid wastes from irrigation	<ul style="list-style-type: none"> <li>Proper waste management</li> <li>PPE provision</li> </ul>	•	•	•	•	•	•	•

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			√	√	<b>Injury from wild animals</b> –Insects, snakes bites	<ul style="list-style-type: none"> <li>• Prepare sufficient first aid</li> <li>• Prepare health services</li> <li>• Clear sites</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Noise exposure</b> – machines and vehicles produce noise that can affect the hearing of the workers and permanent damage to ears	<ul style="list-style-type: none"> <li>• PPE provision (Ear plugs)</li> <li>• Grease and service machineries and vehicles</li> </ul>	•	•	•	•	•	•	•
		√	√		<b>Confined space</b> -Entry into confined spaces can pose very serious risks for workers, including suffocation and drowning	<ul style="list-style-type: none"> <li>• Sufficient ventilation of workplace</li> <li>• Training of workers</li> </ul>	•	•	•	•	•	•	•
	√	√	√		<b>Traffic accident, fall collision during transportation of material and agricultural product</b> - Agricultural workers use a variety of vehicles for transportation, including buses, trucks, trailers, automobiles, all-terrain vehicles, bicycles and agricultural equipment. Operators and passengers can fall while mounting or dismounting. They can fall within or from	<ul style="list-style-type: none"> <li>• Place rules in control of speed limits</li> <li>• Control speed limits of vehicles around the project sites</li> <li>• Prepare proper Parking area</li> <li>• Aware drivers for their speed limits</li> </ul>	•	•	•	•	•	•	•

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					vehicles during transport. They can be injured by contact with interior paneling or fixtures, other persons, or objects during unexpected stops and starts or in a turnover or collision. Often oxen, donkeys, mules, etc., are often used as a means of transport of people, equipment and goods.								
		√	√		<b>Exposure to bad weather /climate</b> – irrigation is mostly practiced at outdoor at very hot and cold climate conditions	<ul style="list-style-type: none"> <li>• Proper cooling and ventilation of work places in desert areas</li> <li>• Proper heating of the work place in cold areas</li> <li>• Evacuation plan preparation</li> </ul>	•	•	•	•	•	•	•
Loss of jobs				√	After decommission the employers might loss job	<ul style="list-style-type: none"> <li>• Create alternative job opportunity to the workers</li> </ul>	•	•	•	•	•	•	•
Life cycle impact	√	√	√	√	The product life cycle impact on the environment (packing material nature; specially lack of biodegradability)	<ul style="list-style-type: none"> <li>• Use of biodegradable materials in the life cycles of the project</li> </ul>	•	•	•	•	•	•	•
<b>Complaints</b>	√ √ √	√ √ √	√ √ √		Grievances resulting from incompatibility to the local culture, competition over	<ul style="list-style-type: none"> <li>• Training of the proponents to respect the local culture and</li> </ul>	•	•	•	•	•	•	•

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/grievances and Conflicts					employment, loss of control / income of land, flood from irrigation project	norms • Establish conflict resolution committee • Conflict resolution document preparation • Workers and employers participation in conflict resolution • Share job opportunity • Teach about the project							
					Labour issues are always a source of friction between companies and communities and also among community members.								
					When problem is not solved timely and the risk level for the project may dramatically increase								
					Communities/stakeholders and project affected person may turn to protest and conflict which needs Grievances redress mechanisms								