AMHARA NATIONAL REGIONAL STATE WATER ,IRRIGATION AND ENERGY BUREAU (BWIE))

FEASIBILITY STUDY & DETAIL DESIGN OF BORKENA –SAKEI INTAKE SMALL -SCALE IRRGATION PROJECT

VOLUME: VI ENVIROMENTAL IMPACT ASSESSMENT FINAL REPORT

CONSULTANT:
AMHARA DESIGN & SUPERVISION WORKS ENTERPRISE

Amhara National Regional State
Water Resources Development Bureau
(BoWRD)

Feasibility Study and Detail Design
Of
Borkena - Sakei Small-Scale Irrigation Project

Volume VI: Environmental Impact Assessment

Final Report

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FEASIBILITY STUDY & DETAIL DESIGN REPORT STRUCTURE

- Volume I: Watershed Management
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ABBREVIATIONS/ ACRONYMS

ADSWE	Amhara Design & Supervision Works Enterprise
AGP	Agricultural Growth Programme
AIDs	Acquired Immune Deficiency Syndrome
ANRS	Amhara National Regional State
BoARD	Bureau of Agriculture and Rural Development
BoEPLAU	Bureau of Environmental Protection, Land Administration and Use
BoH	Bureau of Health
BoWRD	Bureau of Water Resources Development
DAs	Development Agents
EA	Environmental Assessment
EC_e	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management/Monitoring Plan
EPLAUB	Environmental Protection, Land Administration and Use Authority
ESMF	Environmental and Social Management Framework
FDRE	Federal Democratic Republic of Ethiopia
HIV	Human Immunodeficiency Virus
IAPs	Interested and Affected Parties
IEE	Initial Environmental Examination
IEC	Information, Education, Communication
IPM	Integrated Pest Management
IWUAs	Irrigation Water User Associations
masl	Meters Above Sea Level
MoWE	Ministry of Water and Energy

PCA	Project Command Area
PPE	Personal Protective Equipment
PET	Potential Evapotranspiration
SSI	Small Scale Irrigation
STD	Sexually Transmitted Disease
SWC	Soil and Water Conservation
TOR	Term of Reference
UTM	Universal Transverse Mercantile
VECs	Valued Environmental Components
WRM	Water Resources Management
WUAs	Water User Associations

EXECUTIVE SUMMARY

This report is an Initial Environmental Examination (IEE) of Sakea/Borkena Diversion Irrigation Scheme. It was prepared by ADSWE. The project proponent is BoWRD of Amhara Region and the project's sponsor is AGP.

The irrigation scheme is located in Artuma Fursi woreda, Oromo Zone, Amhara National Regional State on the right side of Borkena River course. The project is intended to transform rain fed subsistence agriculture into irrigated commercial agriculture. It is proposed that up to 192 ha area of land would be irrigated by the water. This would allow improved cropping in the dry season. The project beneficiaries are small land-holders living in and using the cultivable land of the project command area. A total of up to 126 households will be beneficiaries with a land holding size of about 0.5ha.

The proposed project has been assessed in accordance with possible Ethiopian guidelines and funding agency safeguard policies. The project site is selected by investigating different locations along Borkena River course based on its geological stability, capacity to irrigate large command area, low adverse environmental impacts and low construction cost.

The project has both positive and negative environmental and socio-economic impacts, but, the positive impacts outweigh the negative once. The project's positive impacts and anticipated benefits are increasing in agricultural yields and production due to improved drainage, increased and diversified food supply due to the provision of dry-season irrigation water, increasing in land values and price due to irrigation water, increasing in local development and employment, increased opportunities for high value crop productions and increasing and stabilizing household income for 126 farm households. Although the implementation of the project has many benefits; obviously it will have also some potential negative impacts on the bio-physical and socio-economic environment both during construction as well as operation phases unless mitigation measures are proposed. Thus, in this EIA study, the issues that need special attention to realize the sustainability of the project, such as health problems, soil erosion, water-logging, salinization and nutrient leaching, inadequate resources to meet demands, soil fertility and quality maintenance problems and sedimentation are predicted and possible mitigation measures are proposed for each impact in the report**.** Therefore, the study mainly focuses on identifying and proposing mitigation measures for potential negative impacts associated with the implementation of the project.

A number of negative impacts typically of irrigation will not arise in this project since it is small scale modern irrigation project. However, for key potential negative impacts potential solutions are proposed and implementation management and monitoring plans are prepared in this document. So, in order to see the effectiveness of the measures and to take further corrective actions for any detected impacts, concerned bodies (the proponent, BoARD & BoEPLAU) should check the proper implementation of the project using compliance and effect monitoring mechanisms. This can be achieved through the measurement and analysis of the changes on the environment based on the baseline data. The methods used for monitoring will be observation, inspection, discussion, interview, counting or measurement. The internal monitoring activity reports should be produced or prepared at regular time intervals during construction as well as operation phases of the project and submitted to the competent authority. A continuous follow up of the changes and implementation of mitigation measures during construction as well as operation phases is the task of the proponent.

1. Introduction

1.1 Background

The Amhara National Regional State (ANRS) is one of the largest regions in Ethiopia. It extends within a geographical coordinates of 9^0 29'- 14^0 0' North latitude and 36^0 20'-40^0 20' East longitude. The total area of the region is estimated to be 170,152 km^2. The administrative structure of the region consists of zones, woredas, urban administrations and kebeles. Among the woredas nearly half are moisture deficient, characterized by high variability of rainfall; environmental degradation, drought, famine and population pressure.

Amhara Region is one of the regions in the country with vast potential for irrigation development. The region has abundant water resources, all of which is generated within its own territory. The region is endowed with four river basins having a total potential area of more than 0.57 million ha, however, till recently, only less than 2% (76,000 ha) has been developed by modern and traditional irrigation (ABoWRD, 2005).

The majority of the rural people in the region depend on rain fed agriculture for their livelihoods. Farmers earn their livelihoods from the available land resources while manipulating elements of the natural environment. Most farmers in the region do not use improved technologies or inputs. Both crop and animal production are carried out according to centuries old traditions. As a result, agricultural production in the country has remained at a subsistence level and is highly influenced by occasional and frequent droughts and other local conditions. Therefore, irrigation plays a major role in sustaining and achieving higher food and fiber production to satisfy the increasing demand for food. Hence, it is the right time for the Amhara National Regional Government to initiate integrated agricultural development program in the region, with the aim of increasing agricultural output which can be achieved through better agricultural practices and intensified irrigation systems within the context of a sound environmental management. On this basis, this EIA study is carried out to identify impacts and to propose possible mitigation measures or enhancement mechanisms of the Sakea small scale irrigation scheme.

The Sakea small scale irrigation scheme is one of several proposals for irrigation development in Oromo Zone, Artuma Fursi Woreda, Bishi Adeda kebele. Borkena is relatively a big perennial river which has the potential to irrigate large area of land throughout its course. The proposed command area is found on the right hand side of the river course.

The Initial Environmental Examination (IEE) study of the Sakea/Borkena River Diversion Scheme is carried out by Amhara Design and Supervision Works Enterprise, ADSWE (consultant), after an agreement has made with BoWRD. The study is conducted by a team of experts that consists of multi disciplinary professionals (Environmentalist, Socio-economist, Irrigation Engineer, Watershed Expert, geologist and Agronomist).

This Initial Environmental Examination (IEE) report has been structured to cover the topics listed in National & Regional Environmental Impact Assessment Guidelines and to be consistence with World Bank Safeguard Requirements. The report contains eight sections. In the first & second sections of the report it is intended to describe, respectively the objective, methodology, justification of the IEE, Policy and Legal Frameworks, while section three gives the description of the existing physical, biological and socio-economic environment. Section four provides the description of the proposed development project and its alternatives. Section five assesses the expected potential impacts of the proposed project both during construction and operation phases and the proposed mitigation measures of each impact. Section six summarizes and presents Environmental Management and Monitoring Plans. Section seven describes nature of public consultation process, identified stakeholders, their involvement and concerns. The final section of the report presents the study team's conclusion and recommendations. References are provided in a further section of the report. In addition to this annexes are attached to the report.

1.2 Objectives of the IEE Study

The primary objective of irrigation by itself is a social enhancement mechanism that enables the people to increase their food security. In this respect, it would be mandatory for such a project to be implemented in a manner that satisfies the requirements of environmental safeguard principles, policies and guidelines.

1.2.1 General Objective

The general objective of the Environmental Impact Assessment study is to conduct investigations that enable to assess environmental impacts of the development project (Sakea intake irrigation scheme) and to recommend mitigation measures and highlight enhancement mechanisms by preparing possible environmental management and monitoring plans during planning, construction as well as operation phases of the project.

1.2.2 Specific Objectives

Some of the specific objectives of this environmental impact assessment study are:

- To present the baseline condition of the project area
- To identify the main stakeholders, their involvements and concerns on the irrigation project
- To assess the positive & negative impacts of the project on the physical, biological and socio-cultural environments
- To propose possible mitigation measures for negative impacts that will occur due to the implementation of the project and to find enhancement mechanisms for the positive once
- To prepare environmental and monitoring plans

1.3 Methodology and Approach of the study

The IEE study is conducted in line with the Environmental and Social Management Framework (ESMF) and EIA guidelines provided by EPA and BoEPLAU. The assessment of the IEE study is followed by literature review of relevant documents and studies, collecting primary and secondary data using screening checklists & questionnaires, site visit and physical observation of the project area and consultation with stakeholders. And the approach of the study is by analyzing environmental issues [valued environmental components (VECs)] that are identified from field work observation of the project site, literature review, a serious of questionnaire about likely impacts and the experts own knowledge of SSI schemes and Environmental concerns and providing the final report.

Therefore, the assessment of Borkena river irrigation intervention is considered according to its site specific characteristics. Because, when the field work observations are supplemented by literature review and extensive public consultation with a wide range of stakeholders provides the basis for a diagnostic of the principal environmental issues.

1.4 Justification or Need of the IEE

The primary objective of the irrigation scheme is the sustained increase in food security and household incomes from intensified and diversified agricultural production; however, there are also adverse effects that will occur due to the implementation of the project. Therefore, to make the project socially acceptable, economically feasible and environmentally sound and sustainable diagnosing of the principal environmental issues & examination of the impacts that need to be avoided or mitigated during the planning, design, feasibility study and operation periods is

important. Thus, the environmental issues identified during the screening process, ensure the requirement of IEE as a tool to integrate environmental and socio-economic issues in the project planning.

According to National and Regional as well as International Guidelines projects are classified in to different schedules based on impact significance. Therefore, this Small scale irrigation project is categorized under the list of Schedule II or Category B projects; that require Initial Environmental Examination (IEE).

1.5 Scope of the Study

The EIA study of this irrigation scheme includes describing the baseline condition of bio-physical and socio-economic conditions of the project area, describing the intended project and presenting its alternatives, identifying the major impacts of the project on the environment, proposing mitigation measures for adverse impacts and enhancement mechanisms for positive impacts, describing public consultation process and finally preparing environmental management and monitoring plans.

1.6 Assumptions and /or Gaps in Knowledge

Reliability and quality of data collected with regard to the proposed project from different sources involves some degree of uncertainties due to absence of available official documents and sufficient information and secondary data from concerned sector offices both at kebele and woreda levels. However, the consultant tries to avoid the constraints and limitations by conducting site visit & observations, interviewing concerned stakeholders and undertaking outstanding public consultation forums.

2. The Legal Institutional and Policy Framework

2.1 Organizations Policies and Legal Aspects Pertinent to the Environment

Ethiopia is ruled by a federal democratic government. Policies are formulated by the central government in consultation with regional governments. As such, the concepts of sustainable development and environmental rights as well as the institutionalizing and mainstreaming of environmental concerns have their legal roots in the Constitution of the Federal Democratic Republic of Ethiopia. Article 92 of the constitution declares, among other things, that programs and projects' design shall not damage or destroy the environment and government and citizens have the duty to protect the environment. The 'environment' is taken here in its wider context as including the physical, biological and socio-economic aspects.

Much of the policies, legal and organizational aspects, directions and guidelines pertinent to the environment have their foundation in proclamations such as the "Environmental Protection organs Establishment proclamation (Proc.no.295/2002)" which stipulated the need to establish a system that enables to foster coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels. The proclamation has also required the establishment of Sectoral and Regional Environmental Units and Agencies, respectively. This shows that institutionalizing and mainstreaming of environmental concerns has a legal foundation. The Environmental Impact Assessment Proclamation (Proc. no. 299/2002) which provides a number of guiding principles that indicate and require a strong adherence to sustainable development has made EA to be a mandatory legal prerequisite for the implementation of major development projects, programs and plans. This proclamation is a proactive tool and a backbone to harmonizing and integrating environmental, economic, cultural, and social considerations into a decision making process in a manner that promotes sustainable development. The" Environmental Pollution Control Proclamation (Proc. no. 300/2002)", which is promulgated with a view to eliminate or, when not possible to mitigate pollution as an undesirable consequence of social and economic development activities is also another strong legal instrument. This proclamation is one of the basic legal documents, which need to be observed as corresponding to effective EA administration.

It can, therefore, be stated that environmental protection, be it associated with development interventions or not, has a strong legal basis which extends from the federal government right down to the constituent at the lower strata of administration in all national regional governments.

However, there are some problems in the implementation process; especially reflected in the frequent changes in the mandates and responsibilities of government organizations at all levels, which of course has been ameliorated by the system of management and administration now being already laid at all levels known as Business Process Re-engineering (BPR).

2.2 Water Policies and Proclamations

Ethiopian Water Resources Management Policy is set out in Proclamation No. 197/2000 (the "WRM Proclamation"). The policy is intended to promote comprehensive and integrated water resources management and optimal utilization of available water resources for sustainable socio-economic development. *Inter alia,* the policy calls for conservation and protection of water resources as an integral feature of the water resources planning and development process, and therefore mandatory EIAs of all water resource development projects (see Chapter 5 of the EPA's 2003 EIA Procedural Guidelines which cover water development for agriculture and hydropower, as well as associated resettlement).

The proclamation entrusts the Ministry of Water Resources [now Ministry of Water & Energy (MoWE)] with broad powers to plan, manage, use, administer and protect water resources, including the promotion and implementation of irrigation projects.

The Policy was elaborated in the Ethiopian Water Sector Strategy (2001), also known as the National Water Strategy. The purpose of the Strategy is to translate the Policy into action, with the following specific objectives:

- Improving the living standard and general socio-economic well being of the Ethiopian people.
- Realizing food self-sufficiency and food security in the country.
- Extending water supply and sanitation coverage to large segments of the society, thus achieving improved environmental health conditions.
- Generating additional hydro-power.
- Enhancing the contribution of water resources in attaining national development priorities.
- Promoting the principles of integrated water resources management.

The Strategy is a comprehensive document, covering all aspects of water resources development and management. *Inter alia*, it calls for mandatory EIAs for all water projects, and promotes gender

mainstreaming (see Section 3.3.12). From an environmental point of view, it is challenging that the Strategy includes a call to "Reclaim existing wetlands" by drainage and other means, but not for their conservation or the protection of wetland values.

2.3 World Bank Safeguard Requirements

The World Bank's safeguard policies [Environmental Assessment (OP 4.01), Water Resources Management (OP4.07), Pest Management (OP 4.09), Natural Habitat (OP 4.04), and Forests (OP 4.36)] are the cornerstone of its support to sustainable development. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for bank and borrower staffs in the identification, preparation, and implementation of programs and projects. Safeguard policies have often provided a platform for the participation of stakeholders in project design, and have been an important instrument for building ownership among local populations.

2.4 Relevance and Implementation Strategies of Policies, Legal and Administrative Frameworks

2.4.1 Relevance for the Project

- Communities will benefit from the project by harvesting twice a year on their land and by getting employed to diversify their income. This will not only improve their living standard but also helps to shape future sustainable development activities.
- Implementing these laws will increase awareness about the project while at the same time gives sense of ownership to the surrounding community.
- Security of sustainability of the project will be insured upon implementation of these laws
- Any kind of problems regarding land lease or land ownership will be dealt ahead of time, these laws give protection for the proponent
- This document could be used as a legal document for future activities in the area
- The project will have strong legal standing
- The proponent will have an insight for the pros & cons of the project plus the impacts on the environment by the upcoming project
- Health of the community will be insured
- Workers equality will be assured

2.4.2 Implementation strategies

- Priority will be given to the local community for available facilities
- Public discussion will be prepared regularly
- Clean and healthy environment is unconditional right for community. To insure this, the project will prepare procedural guidelines how to handle and manage impacts
- All damages caused by the project activities at any stage of the project will be compensated properly in collaboration with the local administration
- Meeting will be prepared with the competent agency and the community in order to tackle any problems caused by the project
- All compensation fees were dealt by the government
- A neutral consulting firm was appointed
- This report is written according to the national and international guidelines
- Discussion with the community was insured from the beginning of the project
- Comments and suggestions of experts were included
- Submission of the EIA report to the competent agency will be done
- Supervision of adverse impacts will be done
- Protective wears will be given for workers involved in construction
- The management team will give all the support for the upcoming IWUAs

Hence, with regards to the irrigation project under consideration it can be said that there are adequate policies, legal frameworks and organizations extending from the federal up to the project level that can work in a coordinated manner in such a way that the project functions in an environmentally sound way ones the EIA is endorsed with its pertinent, environmental mitigation, monitoring and management, recommendations. It is believed that, the institutional setup and operational mechanism already recommended by the consultant, by the report on institutional requirement for the diversion weir irrigation and overall area development, has among other things taken care of all the aspects required for the social, economical and environment feasibility of the project.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT OF THE PROJECT AREA

This section describes the baseline conditions of the project area based on the setting of the proposed irrigation scheme under physical environment, biological environment, and social and economic context. The environmental setting is a record of conditions prior to the implementation of the proposed project. It serves as a primary benchmark whether changes occur or not due to the intervention of the project.

3.1 Physical Environment

3.1.1 Location

Sakea/Borkena Irrigation scheme is found in Amhara National Regional State (ARNS), Oromo Zone, Artuma Fursi Woreda, specifically in Bishi Adeda kebele in Borkena watershed (Fig.1).

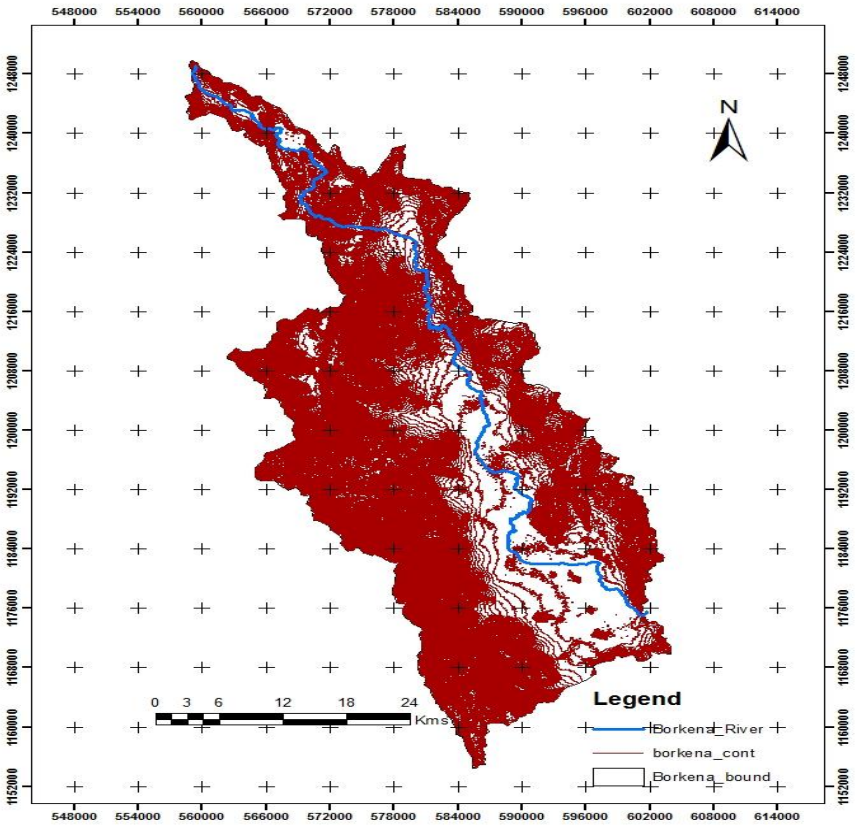

Figure 1: Borkena Watershed Map

3.1.2 Topography

Topography is an important factor for the planning of any irrigation project since it influences method of irrigation, drainage, erosion, costs of land development, mechanization, labor requirement and choice of crops.

Topographically, most of the cultivated lands of the project area are found between nearly level lands. In general, the command area lies in almost flat slope (<2%). Therefore, the slope of the command area has been identified to be suitable for surface irrigation as long as the watershed area would be treated with soil and water conservation (SWC) measures and when awareness is created on the community living around the project area.

3.1.3 Climate

Rainfall is the predominant form of precipitation, which is the most known source of water for plant growth and causing stream flow.

The seasonal variation of pressure and wind system is the cause for seasonal variation of rainfall in the country. The inter-annual oscillation of the surface position of the Inter-Tropical Convergence Zone (ITCZ) which is characterized by low surface pressure causes a variation in the wind flow patterns over Ethiopia in general and the project area in particular.

The project area receives bi-modal type of rainfall pattern based on the nearest station's climate records (i.e. Kemissie station). The main rainy season known as 'Kiremt' occurs from July to October when the ITCZ is in the north. During this season, the south west equatorial westerlies from the Atlantic Ocean cause higher rainfall over Ethiopia.

The small rainy season called 'Belg' rain occurs from March to May when the ITCZ lies across southern Ethiopia. During this period, the moist easterly and southerly winds from Indian Ocean gives the 'Belg' rain to the east including the project area.

The total annual rainfall in the area receives 980.3mm. During the main rainy season (*kiremt*) the project area receives 643.9mm out of which the highest rainfall occurs during August. While during small rain season (*Belg*) the project area receives 213.8 mm during March, April and May (Fig. 2).

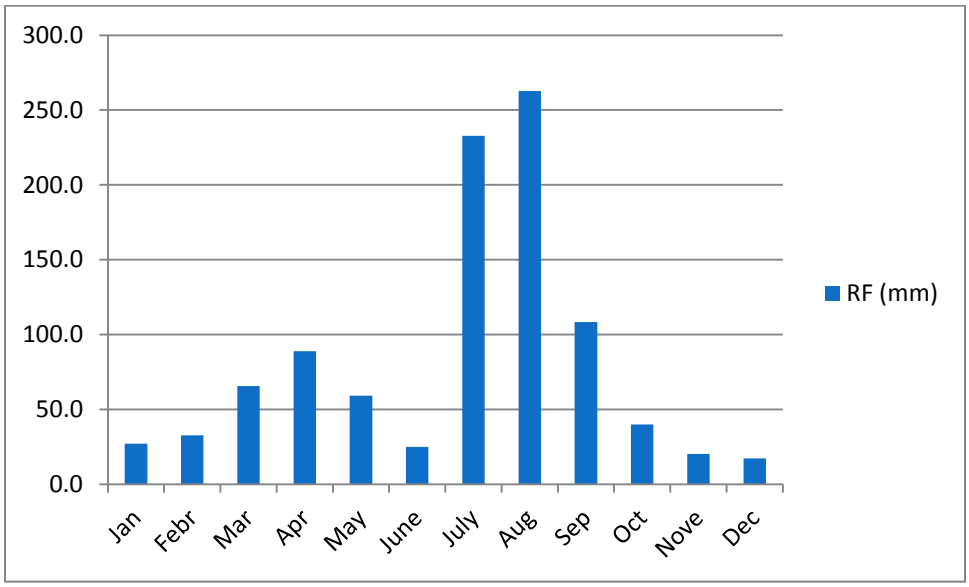

Figure 2: Monthly Rainfall Distribution of the Project Area

Optimum temperature plays an important role on the growth period and production of crops. Average temperature in the project area varies with a distinct temperature range between maximum and minimum. The mean annual temperature in the area ranges from 19.15 °C in December to 25.28°C in June. The mean minimum and maximum monthly temperatures of the project area, ranges from 9.5 °C in November to 16.5 °C in July and 28.4°C in January to 34.3°C in June respectively (fig. 3).

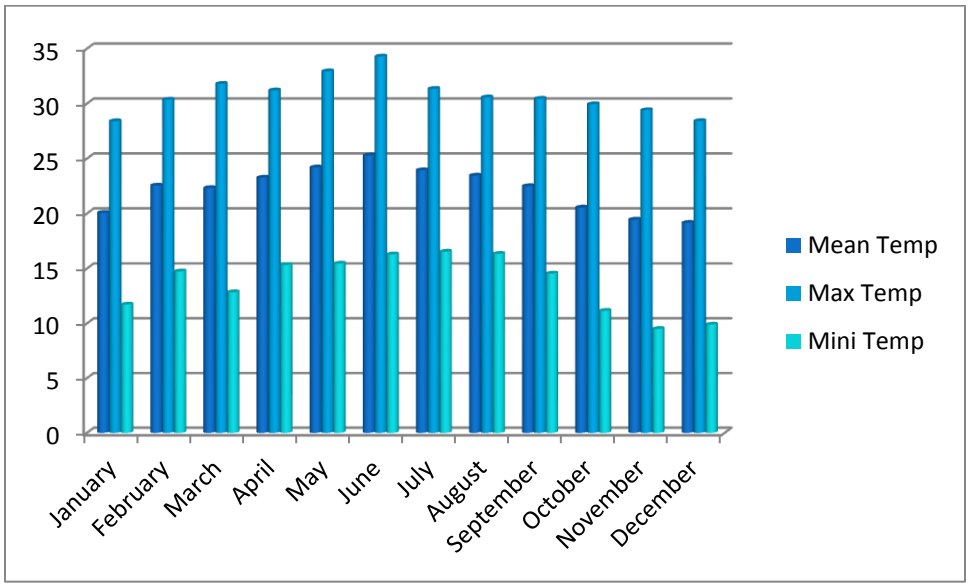

Figure 3: Monthly Temperature (0C) Distribution of the Project Area

Evapotranspiration is the combination of evaporation and transpiration. Evaporation is the process by which water from an open water surface, on the soil surface and water on the leaves and stem of a plant escapes as vapor to the atmosphere through the transfer of heat energy. On the other hand, transpiration is also the process by which water (moisture) in the plant escapes to the atmosphere as vapor through the plant's leaves and stem.

From irrigation point of view, crops need water for transpiration and evaporation. Thus, the crop water need is also called evapotranspiration. The Penman-Monteith Method is used worldwide to calculate PET (the hypothetical evapotranspiration). The input data required are temperature, humidity, wind speed and radiation (or sun shine hours). Thus, the total annual potential evapotranspiration (PET) value of the project area is 1567.76 mm. The monthly PET of the project area ranges from 113.24 mm in December to 159.24 mm in June (fig. 4).

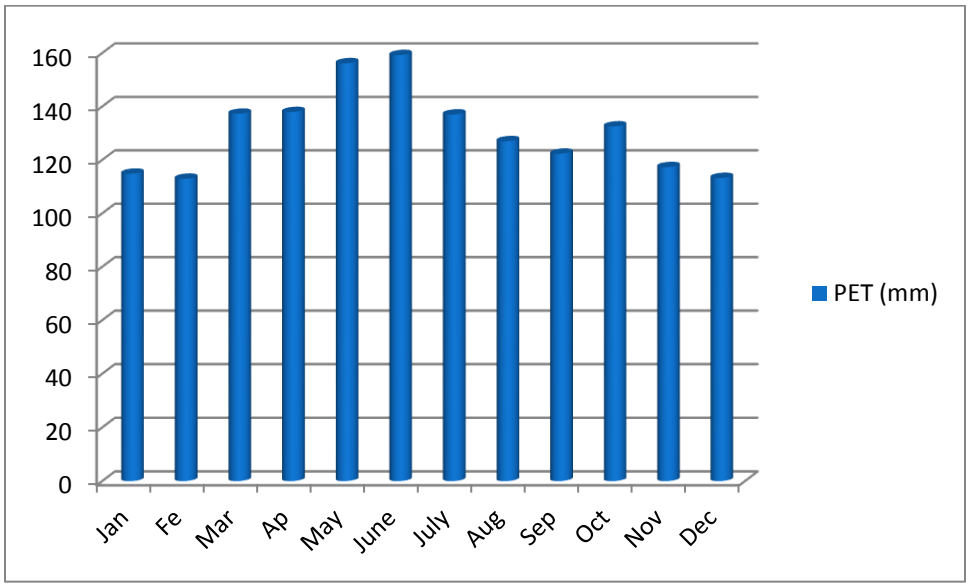

Figure 4: Monthly PET Distribution of the Project Area

3.1.4 Soil

The physical property of the soil (texture) influences the nutrient and water holding capacity, aeration, drainage and workability. According to the soil laboratory analysis result of ADSWE, the texture of the soils in the command area is clay. And the electrical conductivity (EC) of the soil is determined by saturation extracts method, which is, a standard measure of salinity. The soil analysis result indicates EC of the soil ranges from 0.83-1.14 dS/m which is less than 2dS/m. This result shows low salinity effect on crops. The soil pH of the command area in the top soil layer (0-50 cm) measured in a 1:2.5 H_2O soil suspension ranges from 6.8 to 7.58.

3.1.5 Water Resources

In the woreda, small and big permanent rivers and some seasonal streams are found. Of these rivers, Borkena River and Serbuk River are found in the project kebele which provides water for traditional irrigation, livestock watering, and sanitation purpose. The Sakea irrigation scheme is also designed on the Borkena River to sustain food insecurity and to increase crop diversification of the irrigation users.

3.2 Biological Environment

3.2.1 Vegetation (Flora)

The vegetation covers of the project area have been cleared for agricultural activities, for fuel wood and construction materials. As a result, very small portion of the catchment area of the irrigation scheme is covered by scattered trees and bush.

The detailed list of the floral species observed, including natural and plantation trees and grass specious, in the subproject area with their level of intensity is given in the table 1 below.

Table 1: List of trees and grasses specious in the project area with their intensity

Local Name	*Scientific name*	*Intensity*
Natural trees		
Wanza	*Cordia Africana*	xxx
Kurkura	*Ziziphus spina*	x
Keselea Girar	*Acacia spp.*	xxx
Plantation forest		
Bahir Zaf	*Eucalyptus camaldulensis*	xx
Grass species		
Gicha		xx
Maget		xxx

Use x for few, xx for abundant and xxx for widely abundant

3.2.2 Wild Animals (Fauna)

Wildlife and natural habitat are interdependent. No wildlife can exist without adequate food, shelter, water and breeding sites. It is obvious that the most important habitat for wildlife is forest (vegetation). As the information collected from the community living in the area and from observation point of view, much of the natural habitat for wildlife within the project area has been protected from intensive distraction. As a result many wild mammals are found in this habitat, though; there is no National Park or Wildlife Sanctuary in the proposed project area.

The common mammals and birds including fish and reptiles found in the project area with their level of intensity are listed below (Table 2)

Table 2 :List of mammals and birds in the subproject area with their intensity

Local Name & English Name	*Scientific name*	*Intensity*
Mammals		
Medaquwa (Dukier, grey)	*Sylvlcapra grimmia*	xx
Outala		xxx
Tota (Grivet Monkey)	*Cercopithecus aethiops*	xx
Kebero (Jackal)	*Canis aureus*	xx
Jart (Crested Procupine)	*Hystrix cristata*	xx
Jib (Hyena, sptted)	*Crocuta*	xxx
Kerkero (Warthog)		xxx
Ayit (		xxx
Bird Species		
Orako		xxx
Hiwa		xxx
Bicha Wof		xx
Simbitea		xxx
Kakissa		xxx
Debenea		xx
Amora		xx
Fish and Reptiles		
Fish		xxx
Zendo		x

Use x for few, xx for abundant and xxx for widely abundant

3.3 The Socio-economic Environment

3.3.1 Population and Settlement

The total population of the kebele is 3383 by the year 2015. Of the total population of the Kebele 1607 are male and the remaining 1776 are female population. The average annual population growth rate of the project area has been about 1.8 percent. The projected total population of the Kebele estimated to be 4833 by the year 2027.

Increasing population from time to time has created a serious burden on the environment particularly manifested in increasing number of land deficit households, high population density, low per capita agricultural production, increasing demands for land based resources and environmental degradation.

Two major livelihood strategies support the overall livelihoods of the majority of the population in the project areas. Crop production, animal rearing and off and non-farm activities, all of them are traditional, subsistence and low yielding.

The settlements are established by a group of households who have usually close blood ties and comprise a group of tukul houses attached to farmlands and homesteads are surrounded by fruits and eucalyptus trees. In general, almost all of the total population of both categories of project area resided in and around the area.

3.3.2 Agriculture

Traditional agriculture (crop and animal rearing), is the dominant livelihood strategy of the majority of the population.

3.3.2.1 Crop Production

Crop production is the main economic activity supporting the lives of the majority of the population for a number of centuries. Traditional crop production system is highly integrated with animal production. Crop production is highly dependent on rainfall with small proportion of small scale traditional and modern irrigation practices by very little number of households.

Though there are significant cropping system variations between the highland and lowland agro-ecologies of Ethiopia, yet it engages the largest proportion of the rural labor force and supports livelihoods of almost all rural population.

According to key informant of the Kebele, some of the main rainfed crops grown in the project area are Sorghum, Teff, maize, Tobacco, Mung bean, Rice and Pepper. Besides, at a slope of about 0-2% land traditional irrigated crops also grown in the project area are pepper, Onion, Maize and Mung bean.

Crop production in the project area, however, is subsistence and for most of the households inadequate to feed the family for a year. It suffers from low utilization of inputs, markets, poor

cultural practices, low access for improved and high yielding seeds, inadequate agronomic practices and poor water management. As a result, substantial proportions of households in the project areas suffer from cyclical and chronic food insecurity.

3.3.2.2 Livestock production

Livestock production is one of the livelihoods of the households. Indigenous animal breeds are the dominant livestock species reared in the project area. Exotic and hybrid cattle population are reared and mainly concentrated around few urban centers and towns of the project areas mainly kept by urban dwellers for milk production. Types of livestock in the project area are cattle population, shoats, equines and camel.

According to the socio economy survey, there are 896 cattle population, 281 heads of shoats, 12 equines (donkey and horse) and 5 head of camel population are in the project area.

3.3.3 Use of Agrochemicals

The agronomic practice in the area is traditional. Oxen are the main source of draught power. The use of agrochemicals is relatively very low. In relation to the use of fertilizers, few percent of the households used commercial fertilizers. Most of the fertilizer is used for rain-fed crops and mainly during the main rainy season. Irrigated vegetables and fruit crops are cultivated mainly without any application of fertilizer in general. The proportion of land under commercial fertilizer is few mainly attributed to high costs of fertilizer; lack of access to improved seeds and in most of the lowland areas the perception of the households that their land is fertile. For these households logging of crops is the main reason for not using fertilizers. Erratic nature of rain and vulnerability of the crop sector too many shocks also limited the application of commercial fertilizer.

3.3.4 Land Use/Cover

According to the kebele Agricultural Office, the kebele comprises about 1746 hectares of land. Nearly 401 ha of land are currently under cultivation. Additional hectares of land don't exist in the kebele as potentially arable land, this severe shortage of land in the project area, will be a constraint for crop production.

Large part of the kebele is occupied by grazing land (67.3 %) which is followed by cultivated land (23%), Built up area (7.2%), bushes lands (1.7 %), and forest land (0.9%).

Table 3: Existing Land Use Pattern of the Project Area

Land use type	Command area		Bishi Adeda Kebele	
	Area in (ha)	% cover	Area in (ha)	% Cover
Cultivated land	300	96.2	401	23
Grazing land	12	3.8	1175	67.3
Forest lands	0	0	15	0.9
Bush lands	0	0	30	1.7
Built up area	0	0	125	7.2
Total	312	100	1746	100

Source: Bishi Aedida Kebele Agricultural Offices.

3.3.5 Experiences in Utilization of Irrigation

The introduction of small scale irrigation and intervention of extension services and improved agricultural markets, though relatively recent, has greatly contributed to the expansion of irrigable crops in the area. Of the total area under crops, very few percent is under traditional small scale irrigation and the largest percent is produced under rain-fed system. This indicates, for the majority of the households, irrigation agriculture is a recent introduction.

3.3.6 Perception of Households to Irrigated Agriculture

The importance of small scale irrigation in crop production is currently increasing with increasing land degradation, declining crop yield, fluctuation of rainfall and above all declining land holding. As a result, most of the households need to intensify their current holding to improve their livelihoods and ensure sustainable food production.

According to the key informants information in the Kebele & woreda majority of the households need to improve and expand their current production area under irrigation. In addition to this the residents of the target kebele reviled to be modern irrigation users and are willing to pay for various charges such as water, canal maintenance, etc. during public consultation process. In summary, there are encouraging needs for the expansion of irrigation agriculture among the majority of the households in the project areas.

In view of increasing population pressure and declining land holding, environmental degradation and food insecurity, poverty and destitutions in the project wereda and the project areas the

development and expansion of farmer managed small-scale irrigation are a prior development strategy to improve livelihoods of the rural poor.

During field observation some plots are under traditional irrigation, even though it is traditional system (fig. 5). This indicates that how the farmers perceived irrigation agriculture is very essential.

Figure 5: Partial View of the Traditional Small Scale Irrigation Land in Command Area

3.3.7 Soil and Water Conservation Activities

Though some indigenous soil & water conservation (SWC) measures were being practiced by farmers in the area for quite some time, extensive SWC activities were being undertaken since the last few years in the region as well as in the project area through mass mobilization. However, this activity had its limitations mainly because the focus was much more on physical measures and the integration with biological and agronomic measures was weak. Hence, soil and water conservation

measures received adequate attention and include primarily the promotion of physical and biological soil and water conservation measures.

3.4 Environmental Health

3.4.1 Disease Prevalence

According to the Kebele Health Post Data, the leading type of disease from top ten diseases in the area is Acute Febrile illness which is followed by malaria.

Though the incidence of malaria is currently decreasing due to distribution of malaria net, chemicals spray and a frequent awareness creation programs, it is still the major epidemic disease in area where the target kebele is located. Malaria is the second health problem in the project area and it is highly aggravated during peak agricultural period (weeding, harvesting and threshing). Thus, a considerable attention shall be required to control and prevent the spread of malaria which directly affects the working force and has an adverse impact on the productivity of the intended project.

Diarrhea is also one of the major causes of morbidity and mortality in the project area, is caused by unprotected water and poor sanitation and hygienic condition. Though access to safe and adequate water has increased for the last consecutive years, still, availability of adequate and clean water is the major problem in the project area. Using unprotected water sources is the cause of morbidity of the community in the expected beneficiary kebeles through water borne diseases. The disease is highly aggravated for children under five years.

3.4.2 Water Supply and Sanitation

3.4.2.1 Access to Potable Water Supply

Providing access to safe and adequate water is one of the key factors for socio-economic transformation since, among other things, water has an interactive linkage with health and education. Good health is crucial to enhance the productive capacity of the community and improve attendance and performance of students, especially for girls by reducing water fetching burden. Thus, availability of clean and sufficient water plays a vital role for sustainability of any development project.

The source of potable water in the project area is hand dug well.

3.4.2.2 Sanitation Waste Disposal

Proper sanitation and personal hygiene is crucial to promote health, improves the quality of the environment and thus, the quality of life in a community. During the site visit we observe, like any other weredas of the region, the sanitation and hygienic coverage of the project area is very low. Moreover, lack of proper collection and disposal of liquid and solid waste management system in the project area as well as in the target and adjacent kebeles will significantly degrade the environment and adversely affect human health.

In rural areas people defecate in the open area which finally would get in to rivers and hence enhance facial oral diseases because majority of people obtain their drinking water from open, none protected sources. Another factor hindering progress in sanitation is the rural people's negative attitude towards the use of latrines, though nowadays they are trying to use latrine as a result of health extension package. Moreover, the people in the project area dump their solid wastes outside mostly near to their houses. The housing condition is also very poor.

4. DESCRIPTION OF THE PROJECT

4.1 Introduction

The Sakea small scale irrigation scheme is one of several proposals for irrigation development in Oromo Zone, Artuma Fursi Woreda, , specifically in Bishi Adeda kebele. The command area is located about 4 km main asphalted road. The Project Command Area (PCA) would have an irrigable area of up to 192 ha (71ha gravity +121 ha pump dewatering) . The proposed irrigation project is to be undertaken on Borkena River and the headwork structures are specifically located at an altitude of about 1403 masl and geographical coordinates of 1179879 m UTM Northing, 3597251 m UTM Easting.

The silent engineering features of the project are bed bar intake type with height 2.5 m, crest length 41 m. Moreover this proposed irrigation system layout comprises one main canal, four secondary canals and elven tertiary canals as shown on the design part. The main canal runs for most of its length across to the contours and several changes of direction are necessary to follow the topography. It crosses three main gullies. The main canal is masonry lined for a length of 3000 meters starting from the intake outlet and the secondary canal. The conveyance system consists of one Main canal to irrigate total command area of 71 ha by gravity system and 121ha by dewatering pump system by providing of night storage in the main canal. The main canal starts from Water abstraction site on right side and conveys water for a length of 3 Km.

Figure 6: Diversion Point of Borkena River

The scheme would be supplied by building intake structures from Borkena River which has an estimated base flow at the intake site about 350 l/s . The slope of the command area is about <2%.

The materials used to construct the head work and different infrastructures of the project are stone, cement, fine & course aggregates and selective materials. Most of the inputs are found in the project area. Rock for masonry stone and crushed coarse aggregates has been assessed during the field within the project area. One of the possible quarry sites has been identified form the head work to about 2km at the east direction of n-s orientations of the ridge within the asphaltic road which is goes to Addis Ababa to the left direction between kemise and Chefa Robit.. Fine aggregate or natural sand fine aggregate or natural sand have been assessed 27km far from the project area. The natural deposits of such materials could found within the Jara River which is found the main asphalt road goes to Addis Ababa and turn to the right before passing of river. Water for construction purposes can be found from the project stream, Borkena, itself and the rest are available in the markets of the woreda towns. Based on this the entire cost of the project is estimated to be 13,742,029.70 ETB (including vat15%).

Some 126 households would be involved in the scheme, as beneficiaries, with a land holding size of 0.5 ha. Farmers would be organized into compulsory Water Users' Associations (WUAs), which would collect fees for maintenance of the canals and formulate bylaws.

Figure 7: Partial View of the Command Area

4.2 Project Study Area Boundaries

For the purpose of impact assessment, different area boundaries were defined for different purposes.

- For irrigation water management, soils and drainage: the project command area (PCA) and adjacent grazing and agricultural lands in Bishi Adeda kebele.
- For social assessment including health and cultural heritage: the PCA plus the settlements adjacent to the PCA with strong social and economic ties to the people and resources within the PCA.
- For hydrology and watershed management: the catchments of the water course crossing the PCA and the Borkena River above and below the diversion point.
- For ecological issues: the PCA, the Borkena River course, and the overall Bishi Adeda kebele area.

4.3 Operation and Maintenance

Operation of the scheme mainly focuses on the structures that control the flow of the water, timely cleaning of floating debris & removal of sediment on the irrigation infrastructures and managing water delivery systems at farm level by organizing users in water users' associations. Whereas, the maintenance tasks are routine activities and repairs that are carried out periodically. These tasks should be carried out immediately after the end of the main rainy season in September and during the rainy season to protect the structures from damage.

According to the Irrigation Agronomy Report of the Consultant, the agronomic intervention recommended is that the irrigation scheme be designed in such a way that it employs primarily household labour throughout the year and that it is not for the time being a complicated enterprise in terms of its size and operation.

As per the study, choice of crops has already been made based on the suitability of the soils (physical and chemical characteristics); adaptability to the prevailing climate (rainfall, temperature and other climatological elements); food and economic value, farmers preference and experience in the production of the crop; Irrigation characteristics of the crop; and finally marketability and potentiality for agro-processing.

4.4 Project Alternatives

Analyzing project alternatives is one part of the IEE process. The purpose of analyzing alternatives is used to ensure the projects sustainability and select the best site among the possible options. To implement this project different options are analyzed to choose the feasible alternative that brings sustainable development by considering biophysical, social, economical, cultural and technical factors.

No project alternative: the "do nothing option" prevents the implementation of the project on the river. This means it limits the socio-economic development of the project area and prohibits the advantages of the local community that gains from modern irrigation scheme. As a result, the benefits such as increased income (production) and improvement of living standard of the community will be lost.

Project site and design alternative: The project site alternatives are analyzed based on the sitting of the head works (intake structures), the canals alignment, construction techniques, and operation & maintenance procedures. With regard to this different sites were investigated along the course of Borkena River in Bishi Adeda kebele. The investigation involves an evaluation of physical (hydrology, geology and topography) biological and social parameters. Among the different sites the site with coordinates 1179879 m UTM Northing, 3597251 m UTM Easting & elevation 1403 masl is preferred due to its geological stability (having bedrock foundation), capacity to irrigate large command area, low adverse environmental impacts, and low construction cost. A number of canal route options have been also considered to choose the canal alignment. The proposed canal routes have been selected primarily due to their high socio-economic benefits and low adverse environmental impacts over the other options.

Time schedule alternative: the schedule for irrigation infrastructure works should be arranged after the rainy and agricultural off seasons, because the local community should be involved during construction works.

Resource alternative: the materials used to construct the project structures are course aggregates of different size, fine aggregates, cement, water and selective materials. These materials are sourced from the project surrounding areas. To prevent the occurrence of impacts on the natural environment excessive retrieval of construction materials from one source should be avoided.

The alternatives are analyzed based on the technical feasibility; economic viability and environmental acceptability conditions. They are also compared and analyzed in terms of site location, design type, time schedule, raw materials (resources) availability, methods of irrigation technology and working procedures. The no project option is also analyzed as one of the alternatives. Finally, the "No Action" alternative has been rejected and the project implementation option is accepted by examining the project benefits to the local community and due to low negative impacts of the project on the environment and the community.

5. ASSESSMENT OF SIGNIFICANT ENVIRONMENTAL IMPACTS AND THEIR MITIGATION MEASURES

This section of the report represents the study team's assessment of the issues likely to arise as a result of implementing the irrigation scheme. For each issue, the analysis is based on the nature of the issue, the predicted impact, its extent, duration intensity and probability, and the stakeholders and/or values affected.

Although the impact analyses are quantified as far as possible, many of the impacts of the irrigation scheme will be indirect. In these cases, and also in terms of 'significance', a qualitative assessment is necessary. These assessments-value judgments- are the study team's professional opinions based on extensive experience of impact assessment.

As in most impact studies, the analyses focus on potential problems and their solutions rather than on the projects overall benefits. However, where opportunities for enhancement occur, these are identified and outlined. The analysis is done taking into consideration the possible impact of the project during construction and operation phases.

5.1 Potential Positive Environmental Impacts of the Project

It is within the scope of the Initial Environmental Examination (IEE) that one has to indicate the positive aspects that come within and without the environment in relation to an envisaged project. This is important due to the fact that responsible bodies will also play a role in such a way that the positive aspects are also enhanced and improved further.

It is possible to have an enormous list of positive impacts (direct and indirect) that can be realized as the result of the implementation of the envisaged irrigation scheme that uses Borkena River water potential of the project area. However, it will be appropriate here to mention the most important ones in relation to the specific physical, biological and socio-economic realities. Hence, these would include:

- Increase in agricultural yields and production, generating additional revenues directly from the project output.
- Increased and diversified food supply all year long fulfilling basic local needs and improvement in quality of life due to new economic opportunities
- Increase in local development and employment (e.g. Infrastructural development)

- Increase in revenues for the local population due to induced development and complementary activities
- Possibility of development of appropriate skills
- Increased opportunities for high value crop productions with access to irrigated water and appropriate irrigation technology.
- Improved forage varieties provided and increase animal productivity and production; and
- Mitigation of drought syndrome. Implementation of the project will be a means for drought syndrome.
- Increase in land values and price due to irrigation water.
- Extremely low disruption of existing settlements which makes project cost lower

5.2 Potential Negative Impacts

The potential negative impacts of the project, which are most often regarded as **external factors** are highlighted as follows:

5.2.1 Occupational Hazards

To build the project several workers will be involved in construction activities. This is highly likely to result in accidents and injuries to workers. In addition, the workers are often involved in risky behavior off-site and therefore potentially subject to high rates of HIV transmission.

Analysis: Construction is a high-risk occupation especially in the absence of basic safety measures and lack of personal protective equipment (PPE) like gaunt, eye glass, working cloths, shoe etc. Such low standards inevitably result in accidents, injuries and occupational health problems which are completely avoidable with simple precautions. On this project accidents may occur at the construction sites and at project-related borrow pits and quarries. Moreover, many construction workers are either males or females living away from home and with money in their pockets; depending on local cultural circumstances, this can result in risky sexual behavior and high rates of transmission of HIV and other STDs.

Mitigation Measures:

- Ensure the presence of Health and Safety standards on site like gaunt, eye glass, working cloths, shoe and first aid kits
- Compulsory HIV/AIDS and STD awareness and prevention (IEC: information, education, communication) training for all workers including truck drivers delivering supplies to the site, and including free access to condoms
- Ensure tender documents include standard best practice clauses for topics ranging from accommodation to waste management and quarry and borrow-pit operation and closure
- Employ the local people for labor work

5.2.2 Health Problems

Even if the project contributes to the economic growth of the area and improving the food security of the households, there will be potential negative impacts on the local people due to water born diseases. Since water born diseases are endemic in the area where rainfall is high and pools of impervious soils allowing ponding of irrigation water (breeding ground for disease vectors). In addition to this the open canals and drainage systems will create favorable conditions for vectors. As a result the increase of water born diseases may increase in the area.

Analysis: The primary health risks associated with this small scale irrigation project is related to water and vector born diseases. This health related environmental impacts should be considered and a good deal of attention should be given to the matters.

Mitigation Measures:

- Conduct training activities and community awareness programmes.
- Design intake structures in the scheme without ponding and incorporate good standards (lined and no stagnation) in the canals during the planning stage.
- Popularize the use of mosquito net

5.2.3 Soil Erosion

The proposed irrigation development involves earthwork activities, construction of canals, drains; head work structures, and farm access roads as well as quarrying and borrowing to obtain construction materials. These activities will remove the vegetation cover and disturb the top soil &

sub-soil and expose it to erosion. Runoff from unprotected or exposed areas ultimately increases sediment load of the river, the canals and drains. In addition to the disturbance some steep slopes of the project area aggravates the erosion rate significantly.

Analysis: Irrigation is achieved by carrying water from an upstream diversion higher in the plain area, along the contour, and releasing it down onto the command area. There will be a number of sites where in order to utilize the irrigation potential, some portion of the command area will contain steeper slopes, five percent or greater, and there will be a potential for erosion.

Erosion within the command area has several detrimental effects. These include depletion of soil nutrients and organic matter content because top soil is carried away, washing out of crop seeds, exposing the plant roots and run-off spilling out of the command area and degrading downstream water sources.

Large amount of soil excavated from near the diversion and quarry sites leave borrow pits and areas that are easily eroded. The unprotected and often unconsolidated soils of these areas then wash down into the reservoir basin accelerating the filling-in of the canals and lessening the effective life of the scheme.

Mitigation Measures: Erosion issues arise and are best dealt with during the design and construction stages. Proper sitting of the command area is the key to deal effectively and efficiently with the potential for erosion within the command area. Because it is likely that the rivers diverted for irrigation are already transporting silt and sediment from within the catchment, it is vital to avoid construction practices which would add to that burden and decrease the useful life of the scheme.

Although most of the farmers will have ample background in dealing with erosion, a number of SSI specific erosion control and avoidance practices (measures) should be suggested as part of farmer training packages; these include:

- Managing flow velocities within the canal system is fundamental, for both erosion control and ease of irrigation water management. It is important to avoid down slope canals where the volume and velocity will be hard to control, canal scouring may occur and irrigation water will erode the crop lands. Depending on local conditions, protected drop structures at suitable intervals, will have to be provided within both the primary and secondary canal systems. Where applicable, siphons to

abstract water from the main or secondary canals may be used to minimize volume and provide better control of irrigation water flows.

- Consolidating quarry sites and re-vegetating borrow areas will be an important means to avoiding and controlling the potentially high erosion and run-off from these highly disturbed areas. Direct seeding with grass or herbaceous plants would be ideal.

In addition to the above practices the following measures should be taken.

- Planting shrubs and grasses on disturbed areas
- Reuse the excavated soil from canals and quarries for leveling and filling quarry sites and borrow pits before abandoned
- Providing cut off drains that dispose the run off to the natural water way and energy dissipating structures & outlets that reduce the flow of storm water

5.2.4 Water-Logging, Soil Salinization and Nutrient Leaching

The potential impacts from water-logging, salinization and nutrient leaching will be aggravated in relation to the scheme intervention.

Analysis: The uncontrolled use of additives in irrigated agriculture can lead to a buildup of salts through the soil profile from the excess agro-chemicals. The introduction of large volumes of water into the soil on a continuous basis through irrigation is likely to change both the soil physical and chemical attributes. Inappropriate management of the water e.g. through excessive irrigation and inadequate drainage will lead to water logging and leaching of water soluble nutrients to levels where they are no longer available for use by plants. Waterlogged conditions will adversely affect growth and developed of many plants including crops; it may also encourage change in natural composition of vegetation by suppressing and encouraging development of various plants respectively. If proper land drainage is not practiced irrigation has the potential of increasing soil salinity through raised water table and accumulation of soluble salts from the water.

Soil salinity problems in relation to irrigated agriculture are well known in Ethiopia, particularly in the large-scale irrigation schemes of the Rift Valley and, indeed, around the world. In the areas where salinity problems are common, even good quality irrigation water (200 ppm soluble salts) can add 0.2 tones /hectare of salts with a normal water application of 10,000 m^3/hectare/year

(Massoud, 1977, as quoted in Tillman, 1981). Even more worrisome is the fact that treating advanced cases of soil salinity are both technically challenging and costly.

Salinization of irrigated lands is caused either by applying saline water or because of the soils themselves have appreciable level of soluble salts. For example, as Eskindir *et al*. (2010) found that in Borkena River below the effluent there are concentrations of salt and other specific ion toxicity when compared the water above the effluent. This indicates that Borkena River may be the causes for concentration of salt over the project area.

Mitigation Measures:

- The use of fertilizer should be regulated and should be based on the recommendation
- The promotion of organic manure in place of fertilizers should be intensified
- Project to incorporate a component on irrigation water management training, coupled with installation of water use control and regulation meters to limit over-irrigation
- Control of the amount of water abstracted from the river through appropriate design of the intake to include facilities for regulating canal discharge
- Installation of appropriate drainage channels to drain any excess water from the farms and to carry away excess agro-chemicals
- There should be training is in percent use of fertilizer, pesticides in agro chemical usage
- There should be adequate and frequent monitoring of soil salinity through analysis of soil carried out before project implementation and with every annual audit

Salinity is very clearly one of those environmental issues best avoided at all costs; sometimes the rehabilitation efforts and the costs associated with them can be substantial, leading to the returns on the investment. Where avoidance is impossible or where there is a chance for salinity emerging during the productive life of the scheme, the following measures can be taken to address the issue and mitigate its impacts. These include:

*Crop choice***:** selection of salt tolerant crops can lessen the impact on the yield.

*Leaching and drainage***:** Leaching combined with the provision of a good drainage network throughout the scheme provides more satisfactory and lasting results.

*Pre-planting irrigation***:** Salts often accumulate near the soil surface during fallow periods; particularly when water tables are high or the seasonal rainfall is below normal. In such instances an application of pre-planting irrigation water reduces the chances of low rates of seed germination and seed survival.

5.2.5 Conflict between Upstream and Downstream Users

Demand for water for domestic supply, cattle, irrigation etc between upstream and downstream users is usually high during lean and dry seasons. The competing demand also gives rise to disputes with regard to sharing of available water and priority use.

Analysis: The proposed irrigation scheme development is planned to utilize the Borkena River water by constructing intake to irrigate about 192 hectares of land. But there will be shortage of water either due to the reduction of base flow during the dry period or improper utilization of irrigation water by users. Therefore; unless properly designed, there will be social conflict among the users.

Mitigation measures:

- Starting with a proper assessment of available irrigation water**:** - The baseline understanding of the amount of water available for this SSI scheme is fundamental to many decisions and practices related to the sustainability of the scheme. It is suggested to develop a standard methodology for realistic and conservative projections of available water and irrigable area under the irrigation scheme. Therefore, the size of the command area is planned based on the available water resource potential, downstream utilization allowance and crop water requirement.
- Efficient farmer use of available irrigation water**:** - Farmers**,** particularly in the target area, should have an implicit understanding of resource scarcity. The suggested mitigation measures to ensure efficient use of this scarce and precious resource are the establishment of a system of water user fees, linked to consumption which underwrite and reinforce the notion of the value of the resource and provide individual motivation for wise use and conservation, careful training of DAs, WUA officers and farmers will be essential to build the local understanding, management capabilities and community responsiveness to the issue of scarce resource and productive trade-off decision making, and crop choice especially in bad years.
- In addition to the above measures the irrigation area of the scheme for perennial crops should be fixed according to the volume of the water available within one hydrological year.

5.2.6 Soil Fertility and Quality Maintenance Problems

Analysis: Irrigation gives farmers the option for second or even third season production, thereby enhancing the productive capability of the limited human environment. Unfortunately, these opportunities for intensifying the agricultural production can have deleterious effect on the quality and fertility of soils of the irrigated plots. Irrigation also increases cropping intensity in turn results in increased removal of nutrient from the soil. If nutrients are removed more rapidly than they are replaced, the system will not be stable, the resource base of the soils will be degraded and crop yields will be reduced. Intensive cropping can also lead to deficiencies of the three major elements-nitrogen, phosphorus and potassium-and some other minor or trace elements such as sulphur and zinc in the soil which are important for crop production.

Mitigation Measures: Application of chemical fertilizers is the most common means of restoring nutrient and is currently being promoted by the government. However, its use should be tempered, taking into consideration the maintenance of soil productivity by maintaining adequate level of organic matter for retention and uptake of nutrients, maintaining essential microbial activity and water holding capacity and soil structure. Chemical fertilizers alone will not maintain soil productivity over the long term. In view of this fact, although judicious use of chemical fertilizers may be recommended, complementary or alternate techniques for maintaining soil productivity should be promoted. Good land husbandry practices including the application of animal manure, inclusion of legumes in the crop rotation, improve the fuel wood supply, so that manure and crop residue are not longer needed for fuel and appropriate water management must be encouraged. Project planners should consider the opportunities for system layout that allows for command area rotation and fallow periods.

5.2.7 Blocking the Movement of People or Animals

The project involves constructing channels, canals and drains of various sizes. There are also crossings on the main and secondary canals.

Analysis: Though, the scheme that will be developed is small in size, the long established main canals will sanction animal and human right-of-way. So, access roads or pathways or cross structures should be built, as necessary, to allow the free movement of people and their animals.

Mitigation Measures: Carful placement of the culverts will be essential to maintain existing social and economic relations and allow the movement of livestock. Additional culverts and crossings are

likely to be necessary over the canals, streams, gullies and drains to avoid disruption of local movement patterns and facilitate scheme operation.

5.2.8 Sedimentation

The catchments adjacent to the command area (the river course and its tributaries) are in poor condition with low productivity and significant surface erosion. Sediment will affect water courses and infrastructures downstream.

Analysis: The project can fail of the sediment load of the water supply is higher than the capacity of the irrigation canals to transport sediment. Sedimentation from within the scheme itself can also be a problem due to the filling of canals by the dug up soil. Canal distilling is a costly element of irrigation maintenance unless measures used to minimize sediment entry are taken place.

Mitigation Measures:

- Apply effective upstream slope stabilization during the dry season to protect erosion that leads to silting of canals
- Undertake tree planting and soil & water conservation activities in the catchment
- Dispose the spoil soils which are dug up for canal construction on the lands which have lowest value
- Providing drainage systems along the canals that discharge the runoff to the natural water way
- Cultivation limits to the river systems should be identified and adhered to strictly.
- Aforestation and vegetation growth should be encouraged especially along the riverbanks

5.2.9 Pollution by Agrochemicals (Fertilizers & Pesticides)

Analysis: Even though agrochemical (fertilizer & pesticide) pollution is not regarded as a major environmental problem; an increase in agrochemical (fertilizer & pesticide) use is likely, particularly for irrigation crops.

Mitigation Measures:

- Develop and promote IPM by giving in service training for extension staff, farmers, WUAs and woreda staff in IPM

- Carry out crop specific research to refine fertilizer recommendations
- Raise capacity of extension service to deliver recommendations to farmers
- Consider the strategic option of promoting organic agriculture (setting up of organic composting as one of the key demonstrations)
- To prevent crop pests, diseases, and weeds the farmers should use physical and cultural methods such as hand weeding or pulling, removing infested crops, and spray of fermented cattle urine
- Reduce pesticide use and improve the time of application & efficiency of the pesticide spray equipment

5.2.10 Poor Construction Techniques

Analysis: The construction of the main intake, laying pipe works, canals construction must be done appropriately and to the recommended engineering designs. Inappropriate construction techniques will lead to poor water regulation, intensive manual labor use and eventually conflicts in the water intake.

Mitigation Measures:

- Design to ensure world recommended standards considering the existing environmental conditions of the project area
- Select competent and qualified contractors
- Proper supervision of construction works
- Final payment to contractor to be done after availing completion certificate

6. ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS

Environmental management and monitoring plans should be seen as a tool to protect environmental degradation for long term benefit to the society by bringing continued socio-economic development and sustainability of the environment.

6.1 Environmental Management Plan

The IEE has identified a number of potential adverse environmental and social impacts associated with the project and has developed mitigation measures for these. It has also identified a number of measures required to ensure that the project's physical investment is converted into sustainable socio-economic improvements of the lives of the intended beneficiaries. Therefore, in order to enhance the positive impacts, the project's potential adverse environmental impacts will be mitigated and its sustainability promoted by implementation of an Environmental Management Plan (EMP). Thus, for the effective implementation of the EMP, various stakeholders should be involved. The EMP should contain the following necessary contents.

- A description of the possible adverse impacts that the EMP is intended to address
- A description of planned mitigation measures, and how and when they will be implemented
- A description of who will implement the EMP and
- A cost estimate and its source, , here the cost of environmental management or monitoring plans could be nil or management (project) overhead depending on existing contracts or normal tasks of the proponent and competent authority (i.e. the source of the budget will be the government budget allotted and financed to each institution in each fiscal year and budget allotted for the project construction)

Accordingly, solutions to the key impacts identified by the study are summarized in Table 4 based on a standard impact assessment approach of avoid, minimize compensate, and enhance. The table also indicates (summarizes) the main environmental issues of the irrigation scheme, the proposed mitigation measures and time of implementation, responsible institutions that implement the mitigation measures, and the estimated cost of implementation.

Table 4: Environmental Management Plan (EMP)

No	*Potential adverse impacts*	*Proposed mitigation measures*	*Timing*	*Responsible Institutions*	*Cost Estimate*
1	**Inefficient Water Use**				
1.1	Water loss during transport	Improved design, construction and timely maintenance & repair system components	Annually	BoARD, IWUAs	15,000 ETB
1.2	Poor irrigation water management	Careful analysis of irrigation water availability of crop water requirements and training of Das & farmers	Monthly	BoWRD, design consultant	7,000 ETB
2	**Soil fertility & quality maintenance under intensified cropping systems**				
2.1	Soil salinity problem	Proper irrigation regimes and farmer & IWUAs training to minimize excess water application	Twice per year	BoWRD, BoARD	4,000 ETB
2.2	Soil erosion	-Proper choice of command area; field leveling within command area; soil and water conservation structures; proper irrigation regimes -Vegetate all soil surfaces exposed by construction	Annually	BoARD	5,000 ETB
2.3	Depletion of soil fertility	Fertilization; crop rotation; intercropping; fallow and green manure crop	Twice a year	BoARD	4,000 ETB
2.4	Sedimentation	upstream slope stabilization, tree planting	Annually	BoARD	20,000 ETB
3	**Water related disease hazards**				
3.1	Increase incidence of water related vectors and diseases	-Avoidance of stagnant water -Training and human behavior modification	Full life of diversion	BoH, BoARD	6,000 ETB/Yr
4	**water quantity and quality maintenance problems**				
4.1	Pollution by agrochemicals	Promote IPM and organic agriculture	Full contract time	BoARD, BoWRD	3,000 ETB
4.2	Inadequate resources to meet	Realize minimum ecological flow	Full contract	IWUAs, BoARD	7,000 ETB

	demands	Improve water use efficiency	time		
5	**Displacement or change in land-use patterns**				
5.1	Impact on downstream users	Proper calculation of net available water Modification of irrigation regime Encourage the community and WUAs to make social norms and user association rules	Construction onwards	BoWRD, BoARD	7,000 ETB
5.2	Barrier effects on new channels, restricted wet season access	Construct additional pedestrian and livestock paths & build all roads to all-weather standards	During construction	Contractor	12,000 ETB
5.3	Loss of Land and Potential Displacements	-Stakeholder consultation and involvement in decision making at all levels -Compensation of land to the farmers	Before the beginning of construction	Woreda Administration	
5.4	Effect of land use change	Livestock husbandry transformation	Construction onwards	BoARD	8,000 ETB

6.2 Environmental Monitoring Plan

Experience shows us that projects with potentially large, significant and uncertain environmental impacts will normally require more intensive supervision. A number of mitigation measures are outlined in the EMP that will eliminate or reduce the negative environmental impacts of the proposed project to the acceptable levels when they are implemented. In order to see the effectiveness of the measures and to take further corrective actions for any detected impacts that may have not been identified (unforeseen impacts) during the IEE process preparing and implementing an Environmental Monitoring Plan is essential.

Monitoring is often divided into two basic categories, compliance and effects. Compliance monitoring relates to whether agreed measures are being implemented on time and to adequate standards. Effects monitoring relates to the impacts of the project on the receiving social and physical environment, and *vice versa*: information on these subjects assists project management to change or improve how things are being done. Therefore, the compliance monitoring will ensure that the various project organizations are implementing the provision of the EMP effectively and on time while the effect monitoring mechanism will check on the impacts which the project is having on the physical, biological and social environment, by regular measuring of indicators. The methods used for monitoring will be observation, inspection, discussion, interview, counting or measurement. The internal monitoring activity reports should be produced at a regular time intervals throughout the project life. During construction period at least two reports and annual reports for the operation phase should be prepared and submitted to the competent authority. A summary of environmental monitoring plan is provided in table 5 below.

Table 5: Environmental Monitoring Plan

No	*Mitigation measures*	*Monitoring objective*	*Parameters to be monitored*	*Method*	*Location*	*Frequency*	*Responsibility*	*Cost*
1	Water loss protection	To improve water use efficiency	Lining and cracking of canals	Visual inspection of system, wet spot or leakage occurring along the canals	Command area, drainages and canals	Quarterly	BoARD, BoEPLAU, BoWRD	15,000 ETB
2	Irrigation water management	The same as above	Poor design and construction, crop water requirements	The emergence of salinity or water logging problems	Same as above	Monthly	BoARD, BoEPLAU, BoWRD	13,000 ETB
3	Soil salinity protection	Compliance	PH, EC_e	Soil tests	Composite samples of soil at 5-30cm depth, each sample to represent about 16 ha	Annually	BoARD, BoEPLAU, BoWRD	10,000 ETB
4	Water logging protection	To determine existence of salts in the soil	salinity	Visual evidence of wet spots occurring within the scheme or in adjacent areas	Within Command and adjacent areas	Annually	BoARD, BoEPLAU, BoWRD	9,000 ETB
5	Soil erosion protection	To determine effectiveness of mitigation measures	Extent and degree of erosion	Visual evidence of soil transport within the catchment and command areas	Catchment and command areas	Annually	BoARD	12,000 ETB
6	Fertility depletion protection	To obtain early warning of changes	Nitrate, P, K, Ca status	Monitoring of crop yields	Command area	Annually	WUAs, BoARD	3000 ETB
7	Sediment protection	To confirm the measures have been implemented	Sediment load	Visual inspection	Canals, drains and head work structures	Annually	Woreda agriculture office	4,000 ETB

8	Water related vectors and diseases incidence protection	To check the presence of health facilities	Illness case reports	Visual evidence, changes in baseline health indicators	Project kebele	Annually	Woreda health office	4,000 ETB
9	Upstream & Downstream users conflict protection	To check the flows are adequate for downstream users	Minimum flow of the river water	Dialogue within and among the communities	Below and above the command area	Quarterly	Woreda administration	2,000 ETB
10	Agrochemical pollution protection	To check fertilizer & pesticide residue	Water quality	Water test	Below and above the intake point of the river	Quarterly	BoWRD BoARD	8,000 ETB
11	Barrier effect protection	To confirm the measures have been implemented	Pedestrian and livestock crossings	Visual inspection	Along the canals	Annually	BoEPLAU BoWRD	2,000 ETB
13	Land use change effect protection	To check the measures have been implemented	Livestock husbandry	Dialogue within and among the communities	Project target kebele	Annually	BoARD	8,000 ETB

7. NATURE OF PUBLIC CONSULTATION

7.1 Introduction

One of the objectives of participatory small scale irrigation program is to develop sustainable approach to small-scale irrigation in the project area and the institutional framework within which the scheme is implemented. This is a crucial element for the success or failure of the irrigation scheme.

Therefore, informing and consulting the public are integral tasks within the Environmental Impact Assessment process in Ethiopia, are required by the sponsor, and from part of best practice. Accordingly as an EIA consultant, we organize and implement a public consultation programme in undertaking the IEE in collaboration with woreda and kebele office authorities.

The consultation was to encompass:

- Informing stakeholders about the proposed irrigation project, and soliciting their concerns
- Involving stakeholders in further refining the definition of issues to be addressed in the IEE, of what adverse impacts might be created, and of what mitigation approaches & measures might thus be appropriate; and
- Soliciting comments on the final IEE report.

To meet the requirements of both the national and regional regulatory authorities and the project donors, different stages of consultation have been implemented by the EA team including:

7.1.1 Stakeholder Analysis

Stakeholder analysis involves stakeholder identification, initial consultation, analysis of stakeholders' interests and experience with participation and participation of the stakeholders in accordance with their capacity and relevance to each issue.

7.1.2 Stakeholder Involvement

During this stage stakeholders were consulted with respect to the significance of impacts and to assist in formulating mitigation measures. This stage was extremely important since it ensured,

through stakeholder internalization ("buy-in"), that the mitigation measures will be acceptable to the organizations' for applying them, and practical, and therefore will actually be implemented.

Mechanisms for this process varies from straightforward discussion with specialists and decision-makers in concerned organizations by meeting at region, woreda and kebele level and focus group discussions with project beneficiaries to obtain necessary data & information on the issues and problems of the study area.

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Mechanisms for the consultation process varies from straightforward discussion with specialists and decision-makers in concerned organizations by meeting at region, woreda and kebele level, focus group discussions and consultation with project beneficiaries to obtain necessary data & information on the issues and problems of the study area. The consultation process, which had been held at the kebele level, was participatory. The participants have expressed their views and remarks on the discussion agendas without reservation (Fig. 8).

The attitude of the community was assessed during public consultation. The consultant has received feedback from the project area residents through formal consultation process. The community is well aware of the proposed project and eagerly waiting its implementation. Although the residents are generally supportive of the project that will lead to economic betterment and increased livelihood opportunities, they have also raised their views and concerns to the upcoming project.

The main issues (agendas) of discussion for the consultation forum were: (a) attitude of the community towards the upcoming project; (b) responsibilities of the local community; (c) dedication of the beneficiaries to form irrigation water user's association; (d) opinion of the community to produce market oriented crops; (e) contribution & participation of the community on the project; (f) views and fears of the community on the project;

During the discussion forum the community reflects their fear, views & suggestions and forwards some questions on the issues as follows.

- They express their willingness to contribute labor power.
- They reflect their willingness to cultivate market oriented crops and to establish irrigation water users' associations and to set by-laws that govern the members.
- The community believes that the project will increase their agricultural yield by cultivating twice a year.
- The community also reflects their fear with respect to the dalliance of the project implementation.
- The community also added their fear on the discharge of the Borkena River during 'Kiremt' season. The project area may be flooded as a result of over flow of the river during rainy season. So they suggested that the canal should be closed during over flow period.

Generally speaking, the project has got acceptability by different stakeholders at kebele as well as woreda levels.

Figure 8: Public Consultation Process

8. CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

Due to erratic rainfall nature of the project area and subsequent crop failures which have resulted in the adverse livelihood conditions of the area, utilization of available potential of the land and water resources in a much improved way is long overdue. The project is beneficial to increase agricultural yield and for crop diversification. However, any development project, in order to sustainability meet its set objectives, needs to be socially acceptable, economically feasible and environmentally sound.

The prime objective of any Environmental Impact Assessment study is, among other things to see to it, whether or not the envisaged meets the desirable characteristics mentioned after thorough investigation of the potential positive and negative impacts of the development on the environment and the possibility for enhancing the positive attributes as well as the mitigation of the negative attributes.

Thus, the study made so far in this respect warrants that, in view of the damages that is currently resulting in from the implementation of irrigation development in and around of the project area, without the benefit of such an assessment, the envisaged project is regarded as environmentally sound and can go ahead given the incorporation of the mitigations made so far. The benefits to the community will by far outweigh the negative social and environmental impacts expected, which of course can be mitigated.

Therefore, in this IEE study impacts on physical, biological and public are predicted and possible mitigation measures are proposed for negative impacts. In addition to this Environmental Management and Monitoring Plans are prepared for sustainable operation of the project.

8.2 Recommendations

The assessment indicates the following actions that should be taken to ensure the project's feasibility and enhance its sustainability.

- Review the project's framework to confirm that mechanisms and funds have been identified for sustainable delivery of all the services and inputs essential for effective functioning of irrigated commercial agriculture, including the necessary social

investments (safe drinking water, health, service and access roads, literacy, lighting, etc.)

- Recognize the local nature of some of the impacts and sustainability issues, and initiate responses at that level (specially: health, IPM, agro-biodiversity, irrigation technologies)

In addition to the above actions, the consultant also wants to forward the following recommendations.

- The dep't of the irrigation scheme should be underpinned by improved catchments area planning.
- Incorporate indigenous knowledge during the design and dep't phases of the scheme.
- Strengthen the institutional capacity at woreda and kebele levels by allowing knowledge sharing by doing, including community sensitization and training.

- Public awareness campaigns should be carried out for the beneficiary communities to sensitise them on general environmental and social management practices;

- As much as possible the programme should encourage the use of environmentally friendly technologies and the government should provide incentive measures to promote the use of these technologies;

- Effective monitoring of environmental and social management plans has to be put in place;

- Deliberate efforts should be made to encourage maximum participation of the community in all stages of project planning and design, implementation and operation;

- The project should strive to use existing local community structures in the management and administration in order to promote ownership and sustainability of the environmental management plans.

- Ownership of the project must be ensured and the farmers themselves must handle management and administrative issues. To bring genuine participation on the other hand, farmers have to be trained to master the principles and practices of the recommended irrigation agriculture.

- Training and capacity building must be objective, need based and practical. Empowerment of the user communities is therefore the prime element to ensure sustainability and ownership of the project.

- Issues such as land redistribution, relocation, cost recovery, and resettlement, if any, need at most attention and thorough monitoring and evaluation as well frequent discussion with the user community.

- The Irrigation projects must be supported by efficient market infrastructure and support services such as rural credit, focused extension services, transport and communications, more affordable energy sources, ware housing and other links for the production and distribution of agricultural products.

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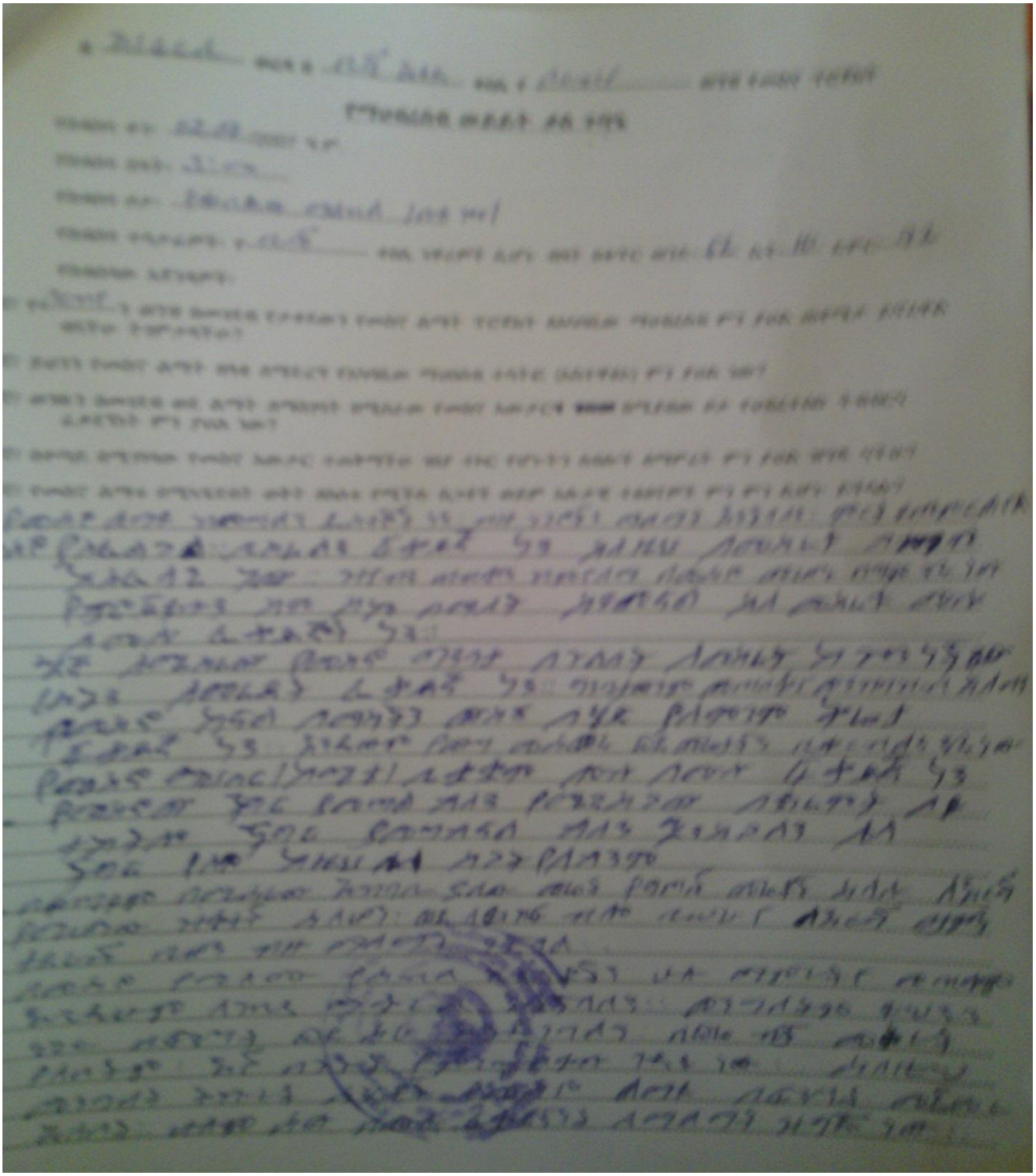
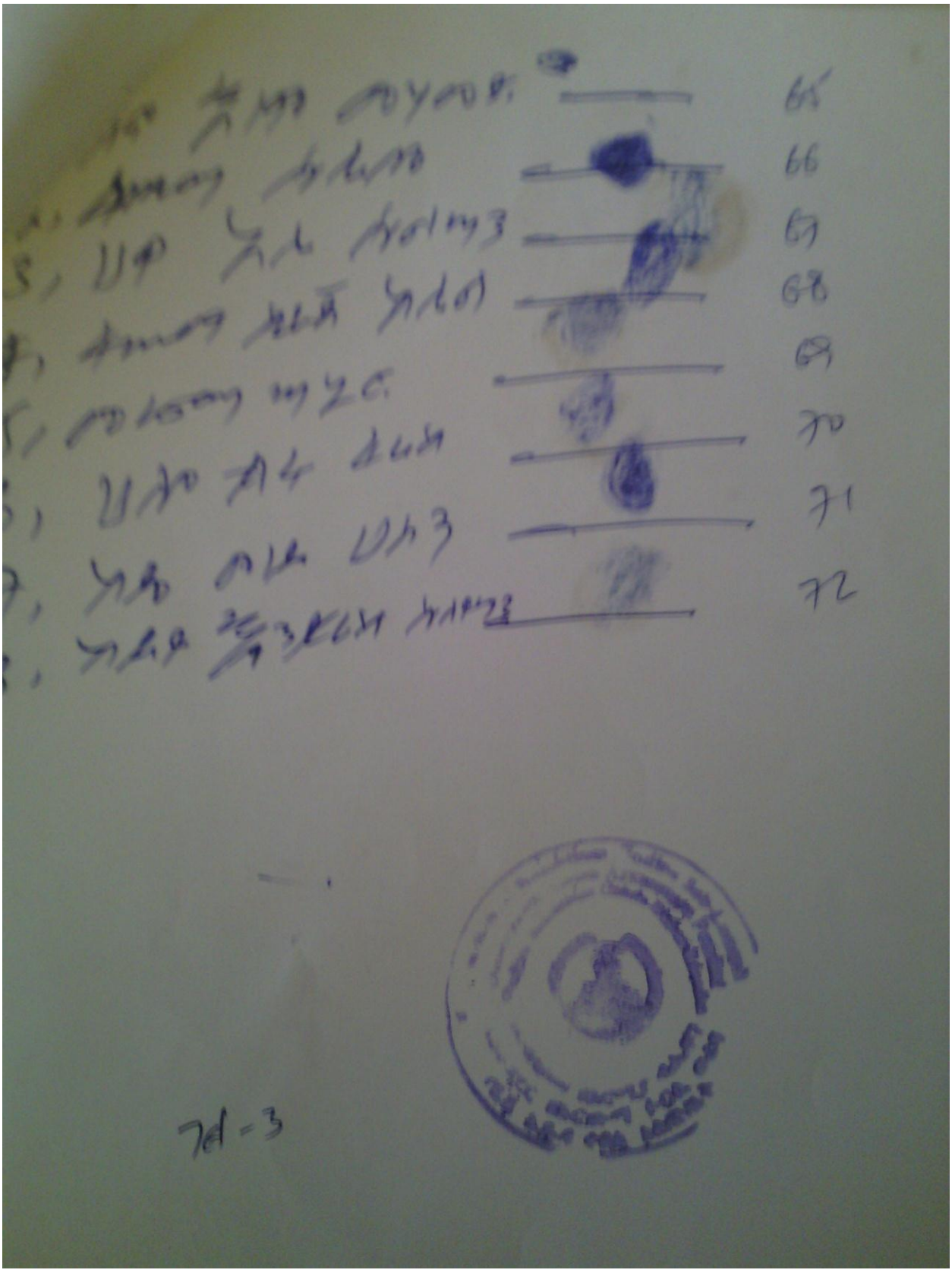
10. ANNEXES

Annex 1 Public Consultation Meeting (PCM) Participant List




Survey on Socioeconomic Data for Irrigation Development Projects



Annex 2 Project Screening Checklist

I. Subproject Activities Illegible for World Bank Safeguard Operational Policies

Features of Concern	***Yes***	***No***
Subproject is in, or adjacent to, an internationally disputed area		
Subproject may involve the physical relocation of residents, involving loss to any household of asset or access to asset		
Subproject is located in a priority area or involves land-use change such as drainage of wetlands and cultivation		
Subproject adversely affects vulnerable groups		
Subproject adversely affects physical cultural resources		

II. Projects Which Need Special Attention

Features of Concern	***Yes***	***No***
Subproject likely to use pesticides or agro-chemicals		
Subproject incorporates construction of a dam		
Subproject involves land acquisition, or loss of assets, or access to asset on the land		

III. Subprojects of Environmental Concern

Feature of concern	***Yes***	***No***
Project located within national park or other designated wildlife area or buffer zone		
Project located in a priority forest area		
Project involves draining of or disturbance to a wetland		
Project located within a recognized cultural site or world heritage site		
Project incorporates a dam		
Project involves abstraction of significant volume of water from international waterways		

IV. Impact Identification and Classification

Issue	***Site sensitivity***		
	Low	***Medium***	***High***
Natural Habitats			
Water quality and water resource availability and use			
Natural hazards vulnerability, floods, soil stability/erosion			
Cultural property			
Involuntary resettlement			
Indigenous peoples			
New settlement pressure created			

V. Checklists of Impacts

Impact	***Potential for adverse impacts***				
	None	***Low***	***Med***	***High***	***unknown***
• **Hydrology**					
Ground water rise					
Water Supply adequacy					
Inefficient water use					
Floods					
• **Water Quality**					
Disruption of existing water courses					
Number of streams crossing or disturbances					
Obstruction of water supply					
Obstruction water to cattle					
Obstruction water to grazing sites					
Pollution by agro-chemicals/pesticides					
Effect on downstream water use					
• **Soils**					
Fertility and Structure					
Creation of quarry sites or borrow pits					
Salinization and water logging					
• **Erosion and Sedimentation**					
Soil erosion at the construction site					
Wet season excavation					
Catchment management					
Roads and quarries					
River Morphology					
• **Ecology**					
Significant vegetation removal					
Wildlife habitats or populations disturbed					
Felling of trees/forest clearing					
Environmental sensitive areas disturbed					
• **Socio-economic issues**					
Disturbance of economic activities leading to loss of property or income					

Damage to historic sites					
Lack of tenancy rights					
Local dispute in water allocation					
Cultural or religious sites disturbed					
Disruption of existing social system					
Economic or physical resettlement required					
Inadequate resources to meet demands					
New resettlement pressure created					
• **Health**					
Water born diseases					
Public health concern					
Communicable & Non-communicable diseases					
Health Service capacity					
Disease Ecology (vector habitat)					
Construction of safety and labour welfare					
• **Design, Management and Agronomy**					
Land tenure and consolidation					
Cooperatives and WUAs					
Institutional capacity and change management					
Pest, Disease (crop &livestock) and IPM					
Access and canal crossings					

Annex 3 Scheme Database Format

- Type of scheme: - Community/Group/Individual
- Category of scheme: - Traditional, Spring, Diversion, Micro dam etc
- Location: - Kebele----------; Woreda----------; Zone----------
- Access to scheme site:-
- Access to market and inputs:-
- Population and households
- Total population---------- Male---------- Female----------
- Number of households under the scheme:-
- Number of FHH under the scheme:-
- Scheme area: - ---------- ha
- Area developed: - ------- ha first season; ---------- ha second season
- Head work (dimensions):-
- Main canal (length, discharge, lined, unlined):-
- Secondary canals (length, discharge, lined, unlined):-
- Tertiary canals (number, length):-
- Structures (inlets, outlets, crossings, division boxes, flumes Etc):-
- Farmers' contribution (no of labour days, material supplies):-
- The watershed characteristics of the area:-
- Response of the community towards the project:-
- Excavation in canals (volume of cut in cubic meter):-
- Topography (slope) of the area:-
- Properties of the soil and water:-
- Climate (rainfall, temperature) of the area:-
- Vegetation cover and type of the area:-
- Project boundaries
- Elevation range of the project site
- Coordinates of command area in UTM (Northing ––––––– to -------, Easting –––––– to -------)
- Existing land holding size ---------ha -------- plots

Annex 4 Questionnaires used to collect primary data

1. Are there the following problems in the area both in soil and water resources?

- Soil:
  a. Salinity 1. Yes, 2. No
  b. Acidity 1. Yes, 2. No
  c. Others (mention)
- Water resources:
  a. Salinity 1. Yes, 2. No
  b. Acidity 1. Yes, 2. No
  c. Others (mention)

2. Is crop damage by wild life expected?

3. For Water resources (irrigation) related plans:

a. Will scheme structure disrupt communication & movement of people, livestock and wild life?
   - ❖ Measures required……
b. What are the existing uses of the water source? .....
c. Will there be conflicts with other users group? .....
d. Will the scheme result in important changes in surface water hydrology and natural drainage in the area? .....
e. Are there external factors which could threaten the plan?
   - ❖ Reduced flow……
   - ❖ Catchment degradation……
   - ❖ High silt load ----------
   - ❖ Source of water pollution……

4. Is the water quality suitable for irrigation development? .....

5. Is the water quality suitable for domestic use? .....

6. Is the soil suitable for irrigation? .....

   - ❖ Permeability risk……
   - ❖ Water logging risk……

1. Is the substratum suitable for canal construction? .....

- ❖ Leakage risk……
- ❖ Siltation risk……

8. Will drainage water affect health and water quality inside & downstream of the command area? ……

9. Will the drainage water affect important wetlands? ……

10. Is there a risk of rising water table, causing Salinization and water logging? ……

11. Is there enough water for the entire command area? ……

12. Are special soil construction works required in the catchment? ……

13. Is the area known for malaria? ……

14. Has the flow pattern of the water source changed over the last few years? ……

15. Will diversion of the river water affect?

- ❖ Dry season flow? ……
- ❖ Downstream water users? ……
- ❖ Downstream riverine ecology? ……

16. Will the scheme development displace people? ……