

ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT OF ABOUT 20,000 HA IRRIGATION AND  
DRAINAGE SCHEMES AT MEGECH PUMP (SERABA),  
RIBB AND ANGER DAM

ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT OF THE  
MEGECH PUMP (SERABA) IRRIGATION  
AND DRAINAGE PROJECT

Volume 2/2: Annexes (Final version)



07 January 2010

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF ABOUT 20,000 HA IRRIGATION AND DRAINAGE SCHEMES AT MEGECH PUMP (AT SERABA), RIBB AND ANGER DAM

## *ESIA of Megech Pump (Seraba) Irrigation & Drainage Project Volume 2: Annexes*

### TABLE OF CONTENTS

Abbreviations.....	iv
Symbols and Units.....	x
Elements.....	x
Monetary Units.....	x
Glossary.....	xi
<b>1. ANNEX 1 - MAPS .....</b>	<b>1-1</b>
1.1 Map 1: Project Area: Administrative Boundaries and Settlements	1-3
1.2 Map 2: MPIDP - Command Area Layout - Orthophoto	1-4
1.3 Maps 3.1 to 3.5: Flood Hazard	1-5
1.4 Map 4: Multi-Spectral Satellite Image of Lake Tana showing Wetlands	1-9
1.5 Map 5: Local Place Names	1-13
1.6 Map 6: Sites of Social Consultation and Other Features	1-14
1.7 Map 7: Possible Sources of Construction Material	1-16
<b>2. ANNEX 2 - PERSONS AND ORGANISATIONS CONTACTED BY ESIA STUDY TEAM .....</b>	<b>2-1</b>
<b>3. ANNEX 3 - ESIA STUDY TEAM (MPIDP) .....</b>	<b>3-1</b>
<b>4. ANNEX 4 - TECHNICAL MATERIAL .....</b>	<b>4-1</b>
4.1 Water Quality Data	4-1
4.2 List of Documents relating to Existing and Planned Water Projects around Lake Tana	4-2
4.3 ARARI Research Projects Planned for 2010 - 2011 for ENIDP	4-6
<b>5. ANNEX 5 - ECOLOGICAL DATA .....</b>	<b>5-1</b>
5.1 Plant Species in Main Habitats in Study Area	5-1
5.2 List of Flora in the Study Area	5-5

5.3 Lists of Birds in the Study Area	5-9
5.4 Extracts from 2007 IBA Bird Count	5-16
5.5 List of Mammals in the Study Area	5-22
<b>6. ANNEX 6 - FISHERIES DATA AND INFORMATION.....</b>	<b>6-1</b>
6.1 List of Small Tributaries of Dirma River	6-1
6.2 Location of Dry Season Fish Sampling Sites, 2009	6-1
6.3 Raw Data on Fish Species Caught During Field Survey (January-February 2009)	6-2
6.4 Labeobarbus Species Composition in River Mouths and Upstream Tributaries	6-4
6.5 Use of the Canals for Aquaculture: Production Potential	6-5
<b>7. ANNEX 7 - RAPID HEALTH APPRAISAL .....</b>	<b>7-1</b>
7.1 Introduction	7-7
7.2 Existing Health Situation	7-11
7.3 Preliminary Impact Assessment	7-24
7.4 Mitigation Measures and Monitoring	7-31
7.5 Conclusions	7-45
7.6 References	7-47
7.7 Appendix 1 - People and Organisations Contacted	7-51
7.8 Appendix 2 - Itinerary	7-52
7.9 Appendix 3 - Health Data	7-53
7.10 Appendix 4 - Maps	7-56
<b>8. ANNEX 8 - PEST MANAGEMENT PLAN .....</b>	<b>8-1</b>
8.1 Introduction	8-4
8.2 Current Situation	8-6
8.3 Future Situation with and without Mitigation	8-12
8.4 References	8-20
8.5 Appendix 1: Persons and Organisations Contacted	8-21
8.6 Appendix 2: Itinerary	8-22
8.7 Appendix 3: Lists of Banned and Registered Pesticides	8-24
<b>9. ANNEX 9 - RECONNAISSANCE PHYSICAL CULTURAL HERITAGE SURVEY .....</b>	<b>9-1</b>
9.1 Introduction	9-5
9.2 Survey Observations	9-12
9.3 Initial Assessment & Recommendations	9-24
9.4 Concluding Remarks	9-26
9.5 References	9-27
9.6 Appendix 1 - GPS Records	9-28
9.7 Appendix 2 - People and Organisations Contacted	9-29
9.8 Appendix 3 - Itinerary	9-32
9.9 Appendix 4 - Heritage Survey Maps	9-33
<b>10. ANNEX 10 - RECOMMENDATIONS FOR TENDER DOCUMENTS .....</b>	<b>10-1</b>
10.1 Construction Supervision and O&M Contract	10-1
10.2 Construction Contract	10-3
10.3 Workplace Housekeeping - Checklist for Construction Sites	10-10

<b>11. ANNEX 11 - TERMS OF REFERENCE (FOR THIS STUDY) .....</b>	<b>11-1</b>
11.1 Introduction	11-3
11.2 ENIDP Implementation Arrangements	11-3
11.3 Project Description	11-4
11.4 World Bank Safeguard Policies	11-6
11.5 Scope of Work	11-7
11.6 Data/Information for Conducting the ESIA	11-11
11.7 Consultant Qualifications And Expertise Requirements	11-11
11.8 Schedule and Deliverables	11-12
11.9 Technical Proposal Contents	11-13
11.10 Annex 1: Relevant Sections from the Feasibility Study TOR	11-13
11.11 Annex 2: Relevant Sections from the ESMF	11-13
11.12 Annex 3: Outline of an Integrated Pest Management Plan	11-21
11.13 Annex 4: EMP Templates	11-23
<b>12. ANNEX 12 - OUTLINE OF FURTHER TASKS .....</b>	<b>12-1</b>
12.1 Outline TOR for Review of Fish Passage Issues	12-2
12.2 Proposal for Rapid Archaeological Impact Assessment by ARCCH	12-6
12.3 Outline TOR for Development of Phase 2 PMP	12-10
12.4 Fisheries Management	12-12
12.5 Aquaculture Trial	12-14
12.6 Lakeshore Restoration Pilot Project	12-16
12.7 Forestry and Fuelwood	12-19
12.8 Domestic Water Supplies	12-20

## ABBREVIATIONS

2,4-D	2,4-dichlorophenoxyacetic acid
AAU	Addis Ababa University
ABA	Abbay Basin Authority
ACSI	Amhara Credit and Savings Institute
ACT	Artemisinin Combined Therapy
ADLI	Agricultural Development Led Industrialisation Strategy
AEWA	Africa-Eurasian Waterbird Agreement
AEZ	Agroecological Zone
AIDS	Acquired Immuno-deficiency Syndrome
AISCO	Agricultural Input Supply Corporation
ANRS	Amhara National Regional State
ARARI	Amhara Regional Agricultural Research Institute
ARCCH	Authority for Research and Conservation of Cultural Heritage
ARRA	Amhara Rural Roads Authority
ARTI	Acute Respiratory Tract Infection
ASDF	Advisory Service Development Fund
ATVET	Agricultural Technical Vocational Education and Training
AWD	Acute Watery Diarrhoea
AWUA	Agricultural Water Users' Association
AWWCE	Amhara Water Works Construction Enterprise
BBF	Broadbed and Furrow
BBM	Broadbed Maker
BBOP	Business and Biodiversity Offsets Programme
BDAMFS	Bahir Dar Agricultural Mechanisation and Food Sciences
BDU	Bahir Dar University
BeSBO	Beles Sub-Basin Organisation
BFALRC	Bahir Dar Fishery and Aquatic Life Research Centre
BIU	Basic Irrigation Unit
BoARD	Bureau of Agriculture and Rural Development (ANRS)
BoCP	Bureau of Cooperative Promotion (ANRS)
BoCTPD	Bureau of Culture, Tourism and Parks Development (ANRS)
BoE	Bureau of Education (ANRS)
BoEPLAU	Bureau of Environmental Protection, Land Administration and Use (ANRS) (formerly EPLAUA)
BoFED	Bureau of Finance and Economic Development (ANRS)
BoLSA	Bureau of Labour and Social Affairs (ANRS)
BoQ	Bill of Quantities
BOT	Build-Operate-Transfer
BoWCYA	Bureau of Women, Children and Youth Affairs (ANRS)
BoWRD	Bureau of Water Resources Development (ANRS)
BP	Before Present (1950)
BPR	Business Process Re-engineering
BRL	BRL Ingénierie
CAADP	Comprehensive Africa Agriculture Development Programme
CACC	Central Agricultural Census Commission
CBD	Convention on Biological Diversity

CBO	Community-based Organisation
CEC	Cation Exchange Capacity
CECE	Concert Engineering & Consulting Enterprise
CEEPA	Centre for Environmental Economics and Policy in Africa
CETU	Confederation of Ethiopian Trades Unions
CFA	Cooperative Framework Agreement
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International Development Agency
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CPA	Cooperative Promotion Agency
CSA	Central Statistical Agency
CSR	Corporate Social Responsibility
CPWF	Challenge Programme on Water and Food
DA	Development Agent
DAP	di-ammonium phosphate
DCG	Drylands Coordinating Committee
DDP	Dams and Development Project
DDT	dichlorodiphenyltrichloroethane
dia	Diameter
DRM	Desktop Reserve Model
DSS	Decision Support System
EA	Environmental Assessment
EARO	Ethiopian Agricultural Research Organisation
EC	Electrical Conductivity
ECX	Ethiopian Commodity Exchange
EEPCo	Ethiopian Electric Power Corporation
EIA	Environmental Impact Assessment
EIAR	Ethiopian Institute of Agricultural Research
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
EMA	Ethiopian Mapping Authority
EMAS	Eco-Management and Audit Scheme
EMP	Environmental Management Plan
EMS	Environmental Management System
ENCOM	Eastern Nile Council of Ministers
ENIDP	Ethiopian Nile Irrigation and Drainage Project
ENSAP	Eastern Nile Strategic Action Programme
ENTRO	Eastern Nile Technical Regional Office
EPA	Environmental Protection Authority
EPLAUA	Environmental Protection, Land Administration and Use Authority (now BoEPLAU)
EPSP	Environmental Protection and Sustainability Process
ERA	Ethiopian Roads Authority
ESE	Ethiopian Seed Enterprise
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESP	Exchangeable Sodium Percentage
ET	Evapotranspiration
EWCA	Ethiopian Wildlife Conservation Authority
EWNHS	Ethiopian Wildlife and Natural History Society

EWNRA	Ethio Wetlands and Natural Resources Association
FAO	Food and Agriculture Organisation
FASF	Farmers' Advisory Service Fund
FEOW	Freshwater Ecoregions of the World
FFI	Fauna & Flora International
FFS	Farmer Field School
FIDIC	International Federation of Consulting Engineers
FPME	Fish Production and Marketing Enterprise
FREG	Farmer Research-Extension Group
FTC	Farmer Training Centre
FWUA	Federation of Water Users' Associations
GARI	Gonder Agricultural Research Institute
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GoE	Government of Ethiopia
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GTP	Growth and Transformation Plan
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
HEW	Health Extension Worker
HIA	Health Impact Assessment
HIV	Human Immunodeficiency Virus
HPP	Hydropower Plant
HSE	Health, Safety and Environment
HTP	Harmful Traditional Practices
IA	Implementing Agency
I&D	Irrigation and Drainage
IAP	Interested and Affected Party
IAR	Institute of Agricultural Research
IBA	Important Bird Area
IBC	Institute of Biodiversity Conservation
IBSRAM	International Board for Soil Research and Management
ICID	International Commission on Irrigation and Drainage
ICOMOS	International Council on Monuments and Sites
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDA	International Development Association
IFC	International Finance Corporation
IHA	International Hydropower Association
ILCA	International Livestock Centre for Africa (now ILRI)
ILO	International Labour Organisation
ILRI	International Livestock Research Institute (formerly ILCA)
IPA	Important Plant Area
IPM	Integrated Pest Management
IPTRID	International Programme for Technology and Research in Irrigation and Drainage
ISO	International Standards Organisation
IVM	Integrated Vector Management
IWMI	International Water Management Institute
IWUA	Irrigation Water Users' Association

IUCN	International Union for Conservation of Nature (formerly The World Conservation Union)
IUCN-EARO	IUCN Eastern Africa Regional Office
KAP	Knowledge, Attitude and Practice
LGP	Length of Growing Period
LLIN	Long-lasting Insecticidal Net
LTTE	Lake Tana Transport Enterprise
M&E	Monitoring and Evaluation
MCE	Metaferia Consulting Engineers
MDG	Millennium Development Goals
MIC	Ministry of Information and Culture
MME	Ministry of Mines and Energy (now Ministry of Mines)
MoARD	Ministry of Agriculture and Rural Development
MoCT	Ministry of Culture and Tourism
MoE	Ministry of Education
MoFED	Ministry of Finance and Economic Development
MoH	Ministry of Health
MoI	Ministry of Information
MoLSA	Ministry of Labour and Social Affairs
MoU	Memorandum of Understanding
MoWE	Ministry of Water and Energy (formerly MoWR)
MoWR	Ministry of Water Resources (now MoWE)
MPIDP	Megech Pump (Seraba) Irrigation and Drainage Project
MSC	Management Services Contract
MWH	Montgomery Watson Harza
NABU	Nature and Biodiversity Conservation Union
NBI	Nile Basin Initiative
NBSAP	National Biodiversity Strategy and Action Plan
NEIP	National Extension Intervention Programme
NGO	Non-Governmental Organisation
NPC	National Project Coordinator
NPEW	National Policy on Ethiopian Women
NPSC	National Project Steering Committee
NRS	National Regional State
NRSCO	National Road Safety Coordination Office
O&M	Operation and Maintenance
ONRS	Oromia National Regional State
OP	Operational Policy
ORDA	Organisation for Relief and Development in Amhara
OSHWED	Occupational Safety, Health and Work Environment Dept.
PAD	Project Appraisal Document
PADETS	Participatory Demonstration, Training and Extension System
PAN	Pesticides Action Network
PAP	Project-affected Person
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PCA	Project Command Area
PES	Payment for Ecosystem Services
PIF	Policy Investment Framework
PMP	Pest Management Plan
PMU	Project Management Unit



PPD	Personal Protective Device / Planning and Programming Department
PPE	Personal Protective Equipment
PPP	Public-Private Partnership
PRA	Participatory Rapid Appraisal
PSNP	Productive Safety Net Programme
PSP	Private Sector Participation
QA	Quality Assurance
QC	Quality Control
RAP	Resettlement Action Plan
RBO	River Basin Organisation
RCBP	Rural Capacity Building Project
RDT	Rapid Diagnostic Test
REF	Rural Electricity Fund
RIDP	Ribb Irrigation and Drainage Project
RiPPLE	Research-inspired Policy and Practice Learning in Ethiopia
RPC	Regional Project Coordinator
RPCO	Regional Project Coordination Office
RPF	Resettlement Policy Framework
RPSC	Regional Project Steering Committee
RSPB	Royal Society for the Protection of Birds
SBD-W	Standard Bidding Documents - Works
SC-UK	Save the Children - United Kingdom
SDPASE	Sustainable Development of the Protected Area System
SDPRP	Sustainable Development and Poverty Reduction Programme
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
SLM	Sustainable Land Management
SLMP	Sustainable Land Management Project
SME	Small-Medium Enterprise
SMEC	Snowy Mountains Engineering Corporation
SOP	Standard Operating Procedure
SP-IPM	Systemwide Programme on Integrated Pest Management
SRI	System of Rice Intensification
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
TAS	Training and Advisory System
TaSBO	Tana Sub-Basin Organisation
TB	Tuberculosis
TBD	To be determined
TBIWRDP	Tana-Beles Integrated water Resources Development Project
TEK	Traditional Ecological Knowledge
TGoE	Transitional Government of Ethiopia
TLU	Tropical Livestock Unit
TOR	Terms of Reference
UAP	Universal Access Plan
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIDO	United Nations Industrial Development Organisation
URL	Uniform Resource Locator

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USBR	United States Bureau of Reclamation
VCT	Voluntary Counselling and Testing
VL	Visceral Leishmaniasis
WASH	Water, Sanitation & Hygiene
WB	World Bank
WCD	World Commission on Dams
WEAP	Water Evaluation and Planning Model
WG	Women's Group
WGS	World Geodesic System
WHO	World Health Organisation
WoARD	Woreda Agriculture and Rural Development Office
WorHO	Woreda Health Office
WPIT	Woreda Project Implementation Team
WUA	Water Users' Association, similar to IWUA in this report
WUBU	Water Users' Basic Unit
WUC	Water Users' Cluster
WUG	Water Users' Group
WWDSE	Water Works Design & Supervision Enterprise
WWCE	Water Works Construction Enterprise

## Symbols and Units

°C	degree Celsius
g	gram
ha	hectare
hr	hour
<i>kata</i>	0.25 ha
kg	kilogram
km	kilometre
km <sup>2</sup>	square kilometre
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt-hour
l	litre
m	metre
mg/l	milligrams per litre
mm	millimetre
m asl	metres above sea level
m <sup>3</sup> /s	cubic metre per second
pH	acidity / alkalinity
ppm	parts per million
qt	quintal (100 kg)
s	second
t	tonne
V	volt
yr	year
µS/cm	microSiemens per cm (a measure of electrical conductivity)

### Elements

C	Carbon
Ca	Calcium
K	Potassium
Mg	Magnesium
N	Nitrogen
Na	Sodium
P	Phosphorus

### Monetary Units

ETB	Ethiopian Birr
EUR	Euro
USD	United States Dollar

Note            1 Euro = ~ 22 ETB as of December 2010  
                     1 USD = ~ 16 ETB as of December 2010

## Glossary

Amicha	Kin-based festive labour
Aygebere	Local vernacular: medium fertility land
Bahir shesh	Cultivation of soil when soft as the floodwater recedes
Belg	Short rainy season, little rains
Buda	Category of people with the evil eye through inheritance (lower status)
Daguasa ses	Local vernacular: low fertility land
Debo / debayt	Traditional mutual help organisation
Dengal	Papyrus
Edir	Traditional savings / credit mechanism in case of death
Falasha	"the Ethiopian Jews"
Got / Gote	Village / hamlet
Guie	Practice of burning soil with crop residues to improve soil structure
Iqub	Traditional savings / credit mechanism
Injera	Pancake made from teff, millet or sorghum; traditional staple food
Kada / kata	0.25 ha of land
Kebele	Administrative area below Woreda, equivalent to sub-county or parish
Kerem't	Long rainy season, main rains
Maresha	Traditional wooden ox-drawn plough
Noug	Niger seed, an oilseed crop ( <i>Guizotia abyssinica</i> )
Rega	Category of Amhara people who are 'pure' and 'noble' (higher status)
Serfej	Local water manager (covers 20-30 users)
Tankwa	Traditional papyrus boat
Teda	Weekly village market
Teff	Traditional cereal crop ( <i>Eragrostis tef</i> )
Tej	Mead (fermented honey drink)
Tsiwa	Traditional faith-based organisation for commemorating saints, angels
Waïna dega	Traditional agro-ecological zone (1800-2400 m asl)
Warsa	Local vernacular: high fertility land
Woitto	Marginalised, lakeshore-dependent socio-economic group
Wonfel	Reciprocal labour
Woreda	Administrative area below Zone, equivalent to District or County
Ye wuha abat	Traditional water distribution organiser/organisation ("water father")

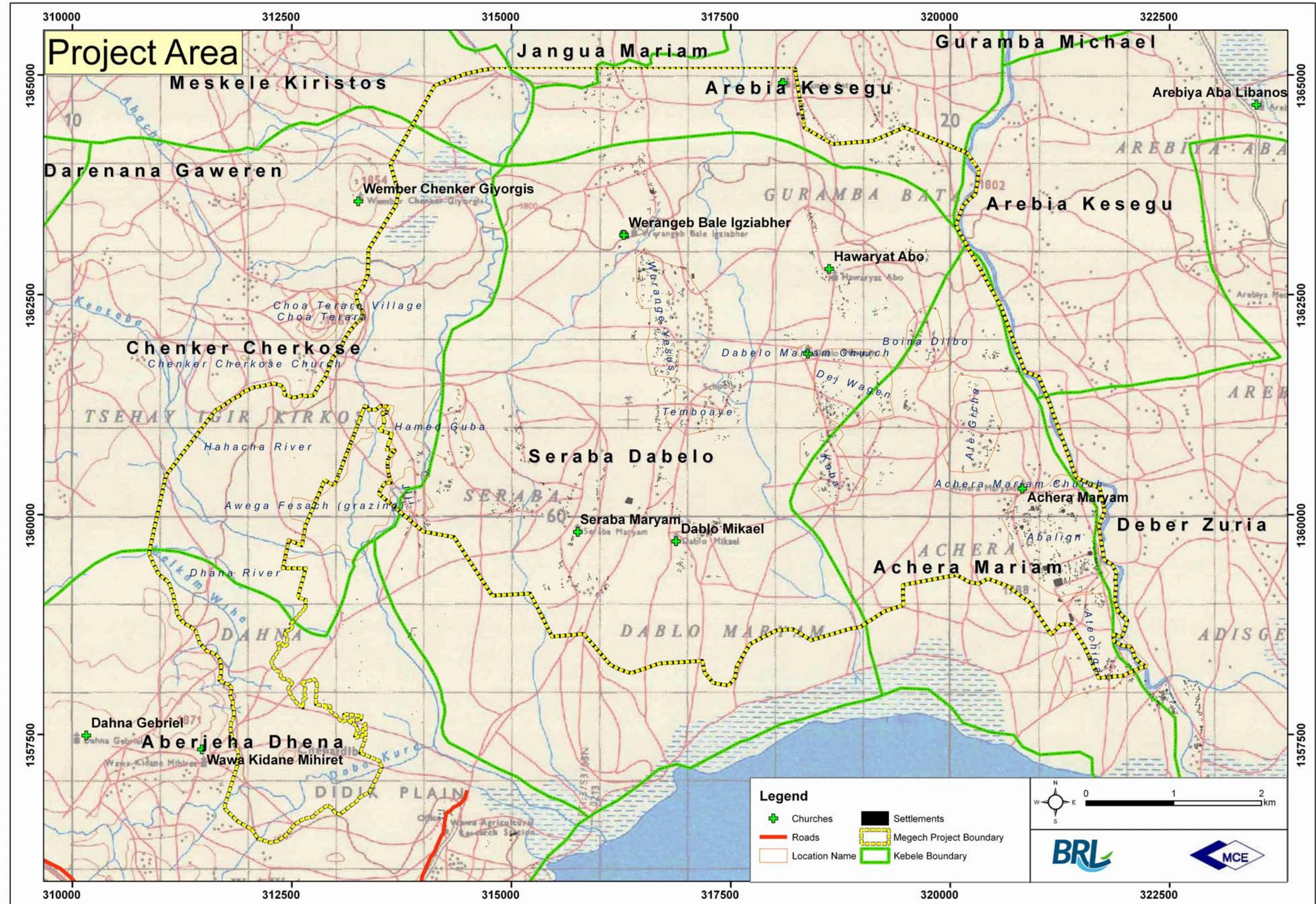


# 1. Annex 1 - Maps

- 1 Project Area: Administrative Boundaries and Settlements (A3)
- 2 Megech Pump (Seraba) Irrigation and Drainage Project - Command Area Layout - Orthophoto (A3)
- 3 Flood Hazard Maps (A4)
- 4 Multi-spectral Satellite Image of Lake Tana showing Wetlands (A3)
- 5 Local Place Names (A4)
- 6 Sites of Social Consultation and Other Features
- 7 Possible Sources of Construction Materials

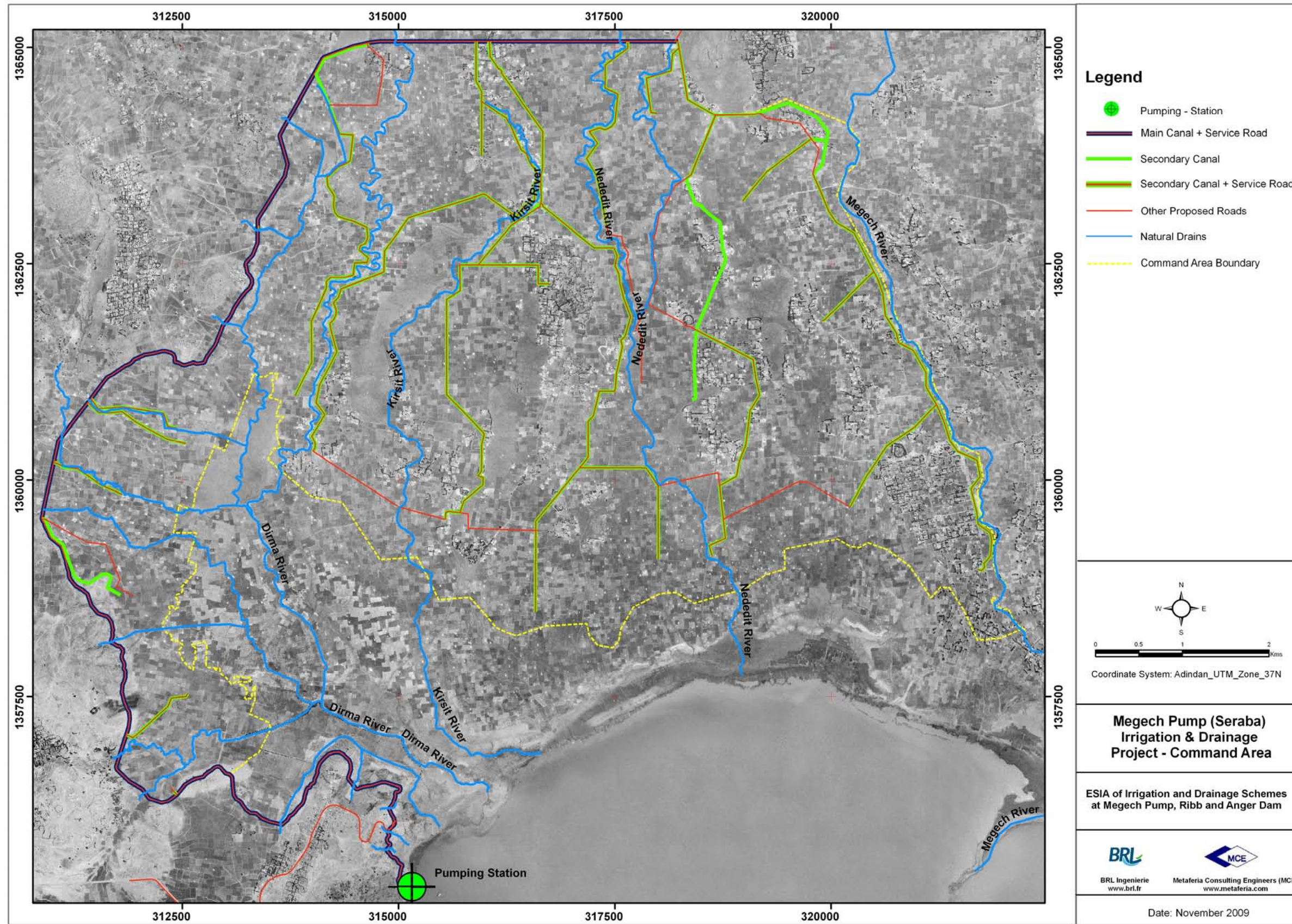


1.1 MAP 1: PROJECT AREA: ADMINISTRATIVE BOUNDARIES AND SETTLEMENTS



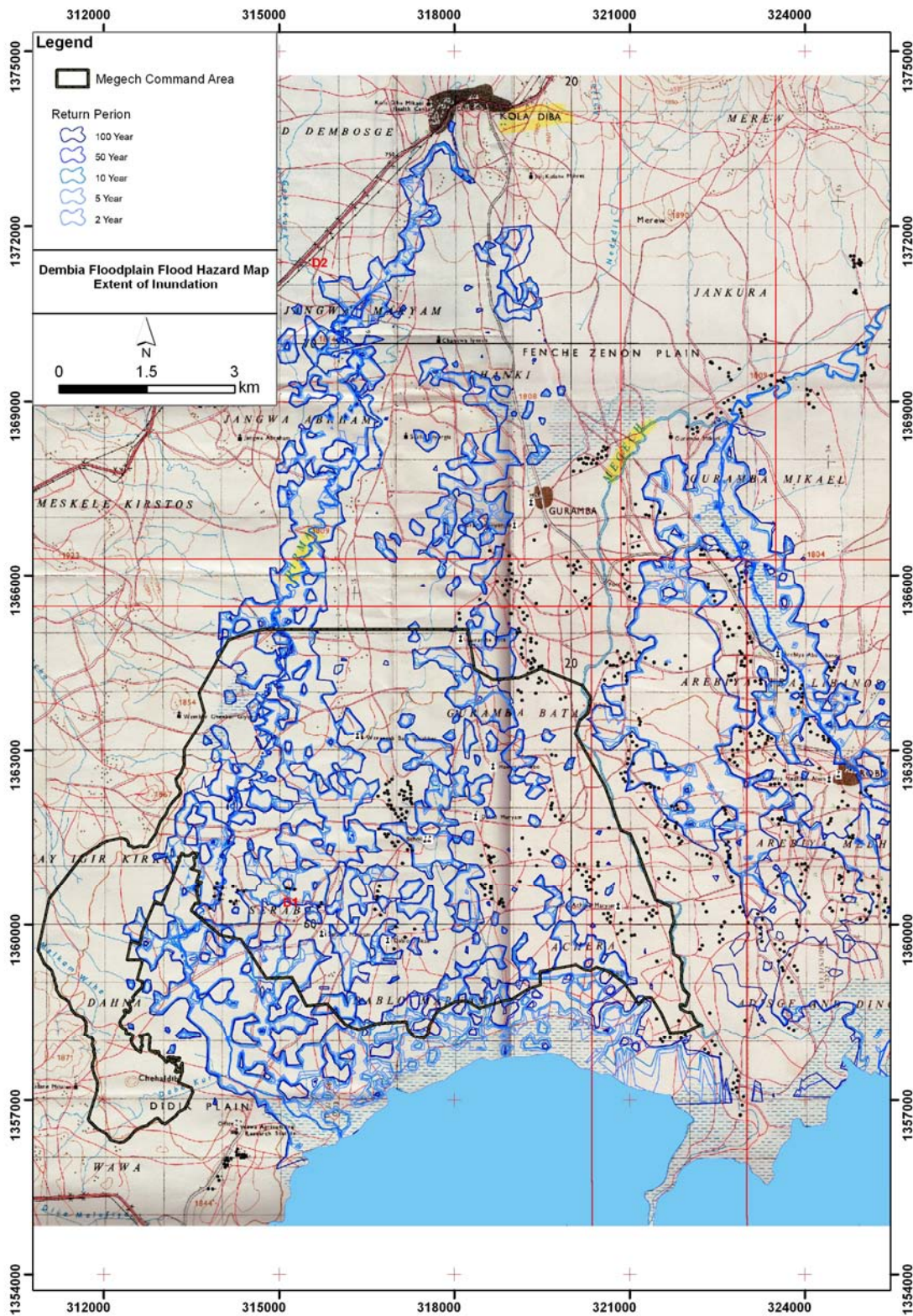


1.2 MAP 2: MPIDP - COMMAND AREA LAYOUT - ORTHOPHOTO



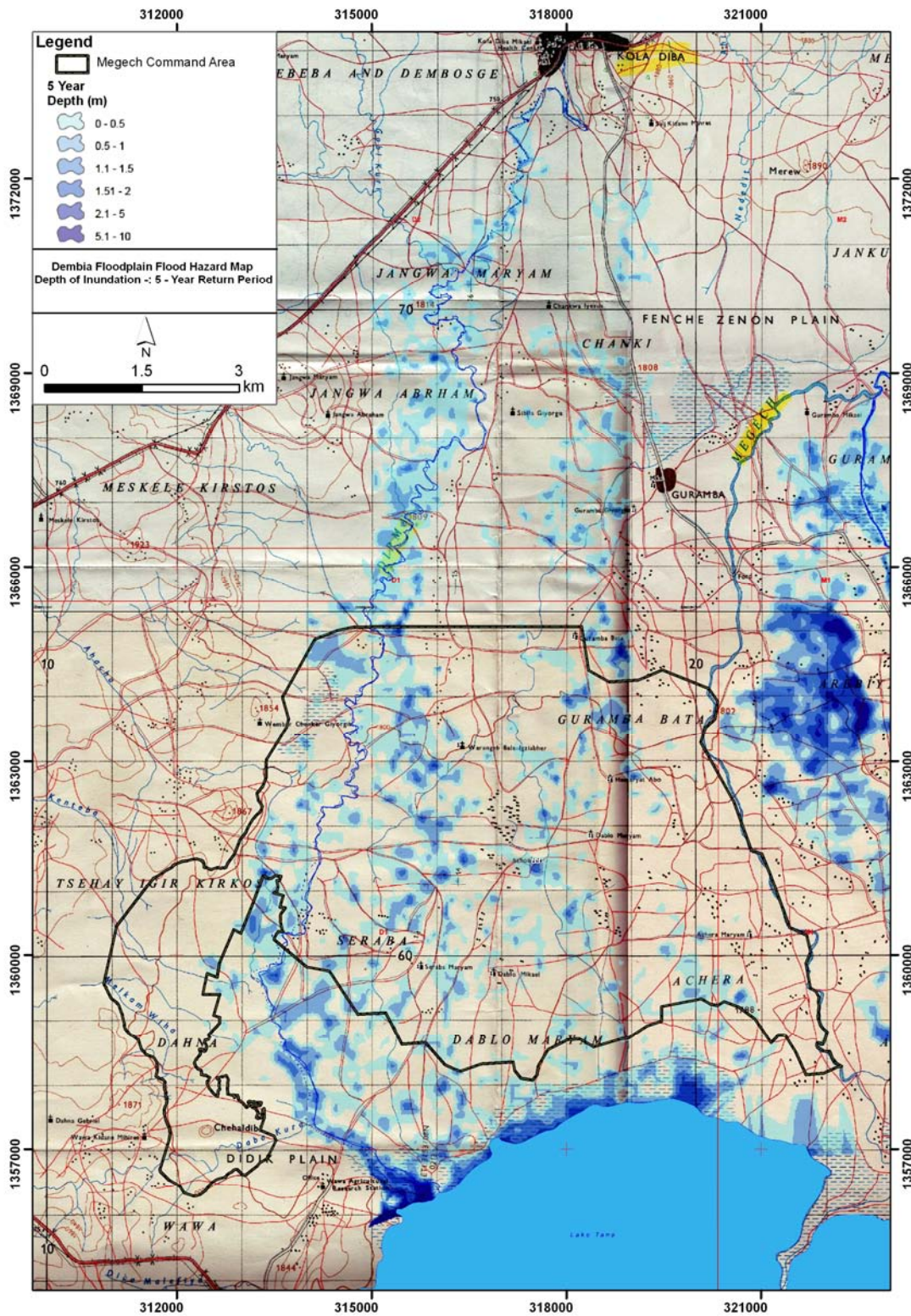
### 1.3 MAPS 3.1 TO 3.5: FLOOD HAZARD

Map 3.1: Extent of Inundation



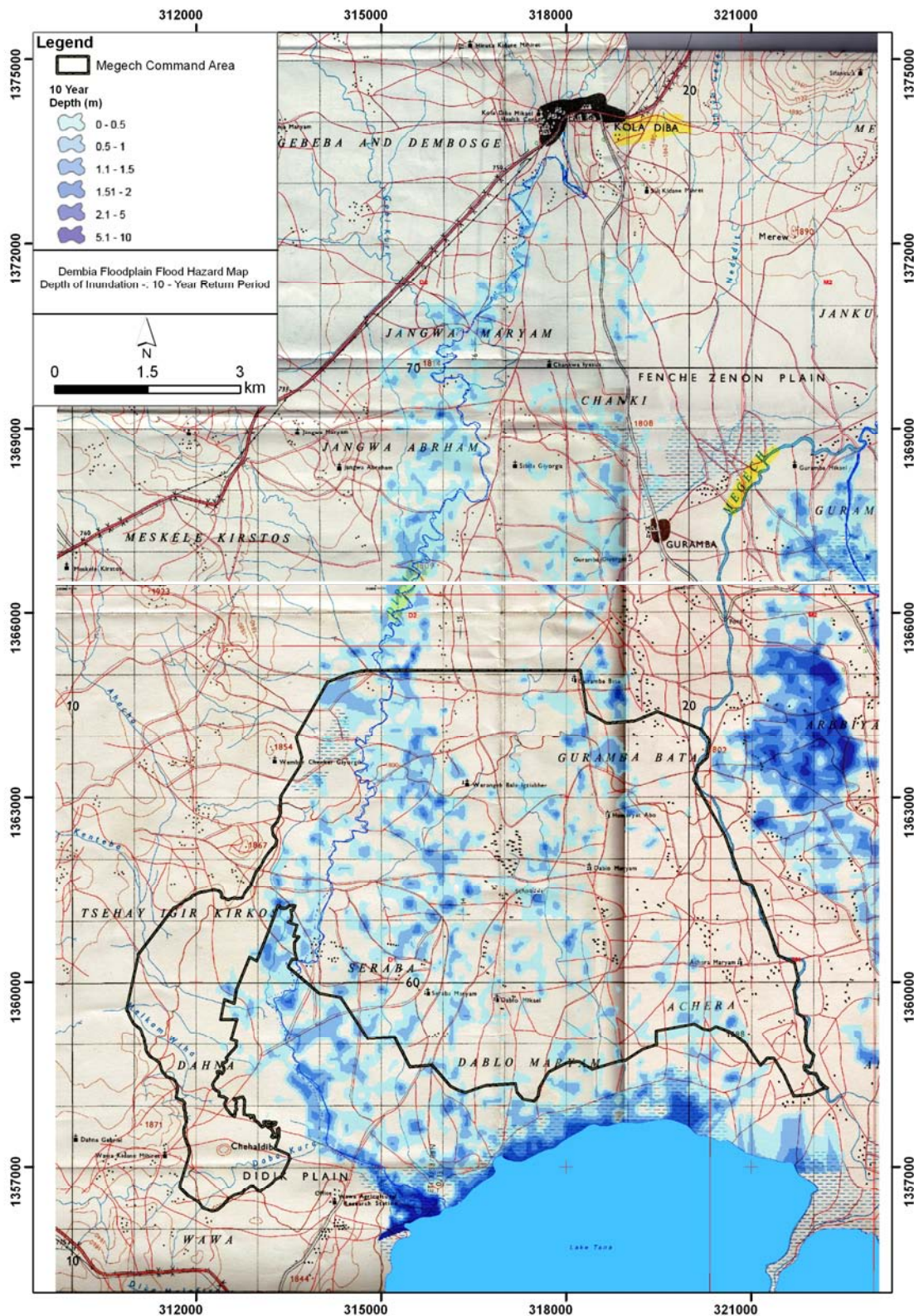
Source: Final Report on Flood Risk Mapping Consultancy for Pilot areas in Ethiopia (Riverside Technology Inc. et al. 2010)

Map 3.2: Flood Inundation, 5-Year Return Period



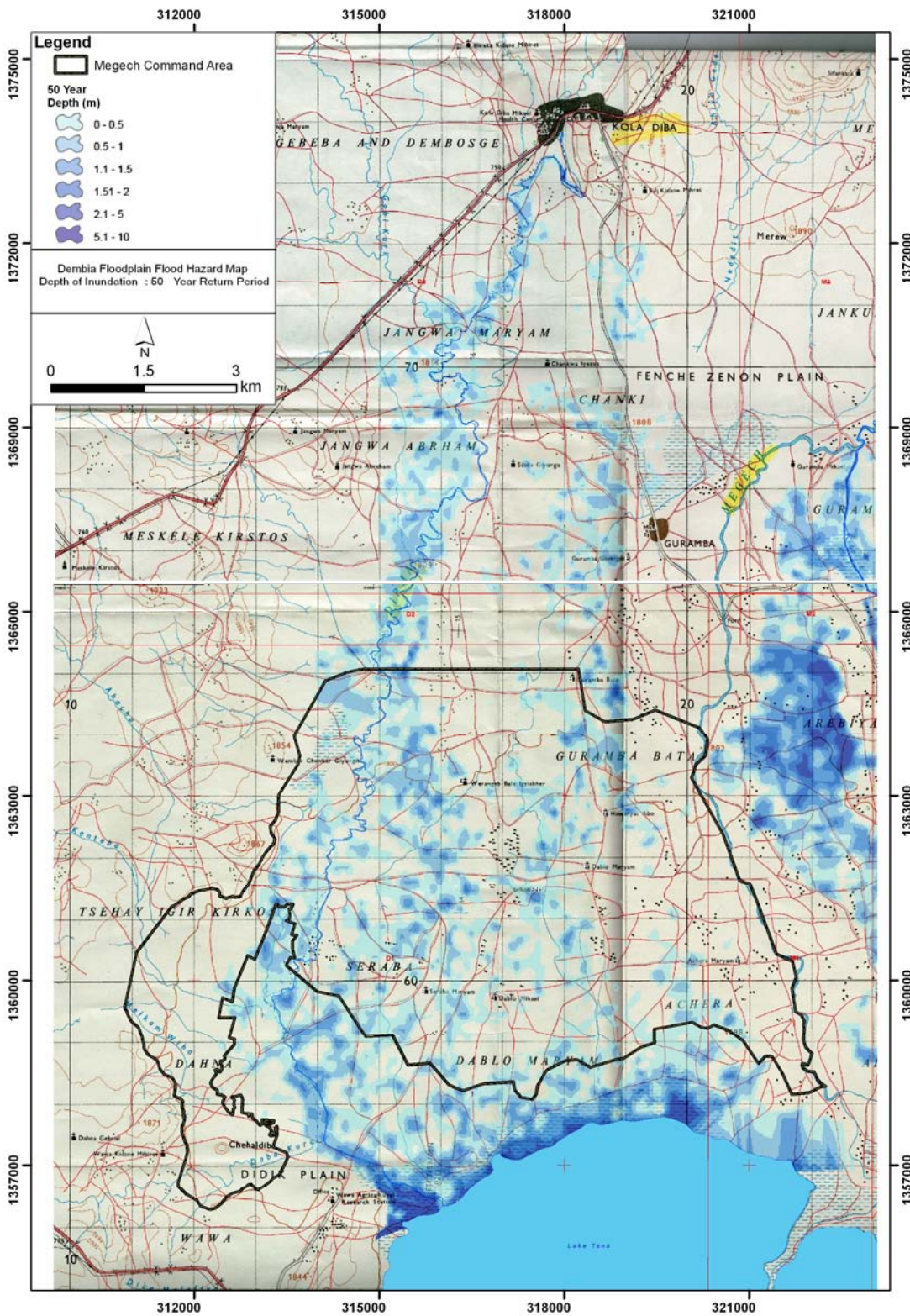
Source: Final Report on Flood Risk Mapping Consultancy for Pilot areas in Ethiopia (Riverside Technology Inc. et al. 2010)

Map 3.3: Flood Inundation, 10-Year Return Period



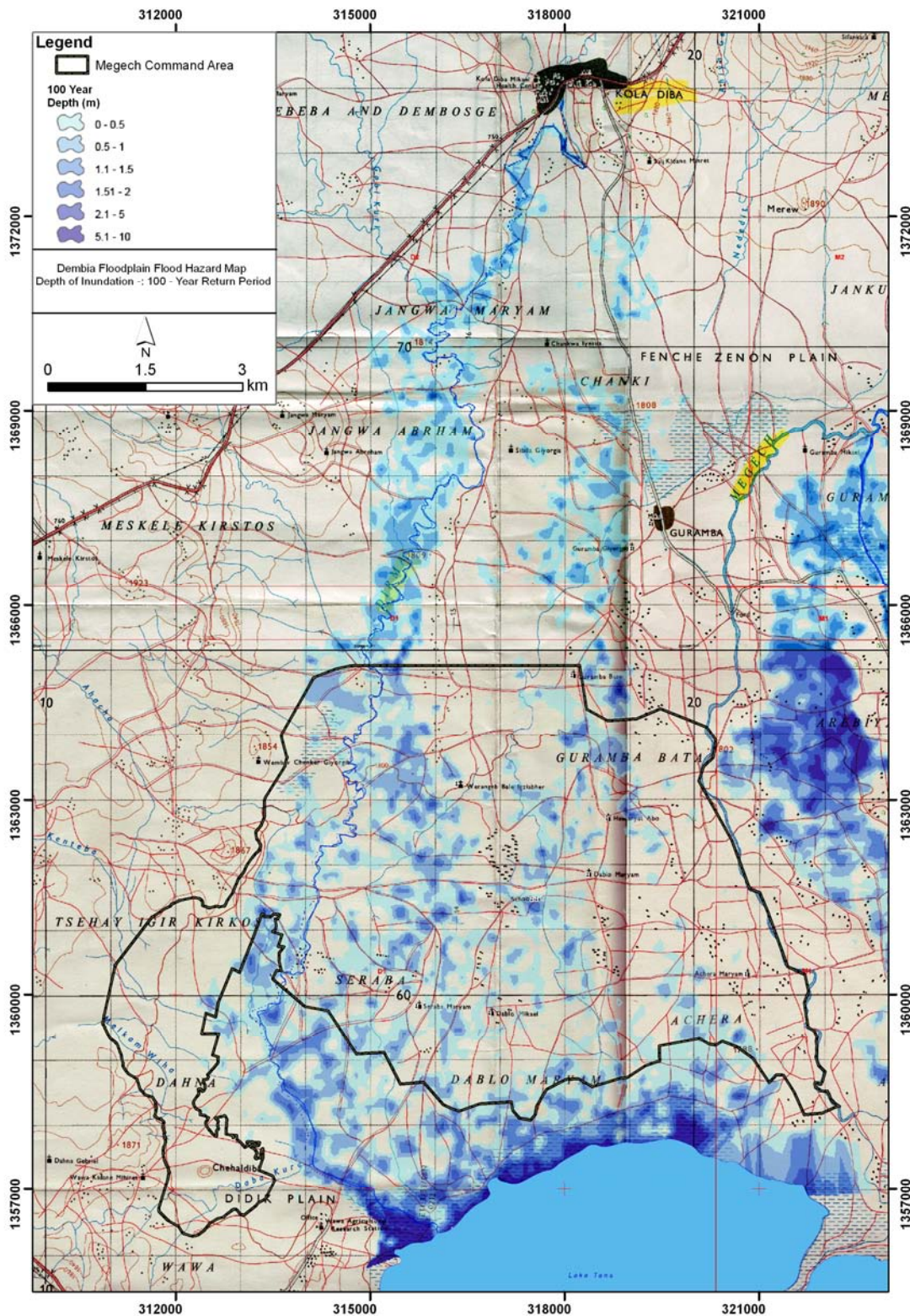
Source: Final Report on Flood Risk Mapping Consultancy for Pilot areas in Ethiopia (Riverside Technology Inc. et al. 2010)

Map 3.4: Flood Inundation, 50-Year Return Period



Source: Final Report on Flood Risk Mapping Consultancy for Pilot areas in Ethiopia (Riverside Technology Inc. et al. 2010)

Map 3.5: Flood Inundation, 100-Year Return Period



Source: Final Report on Flood Risk Mapping Consultancy for Pilot areas in Ethiopia (Riverside Technology Inc. et al. 2010)

## 1.4 MAP 4: MULTI-SPECTRAL SATELLITE IMAGE OF LAKE TANA SHOWING WETLANDS

Semi-automated Approach for Delineating Wetlands - image enhancement, display, and digitising

To generate the image displayed as Figure 22 in the Main Report, various enhancement models were tested to determine the best technique for obtaining a better contrast between wetland versus non-wetland land cover types across different regions over the basin. The most useful displays of Landsat ETM+ image enhancements (e.g., ratios) and band combinations that highlighted the wetlands from non-wetlands, when displayed as RGB (red, green, blue) false colour composite (FCC) combinations, were:

- ETM+4/ETM+7, ETM+4/ETM+3, ETM+4/ETM+2 (or simply: 4/7, 4/3, 4/2); the A3 map on the following page shows this combination, with the wetlands denoted in pale blue.
- ETM+4, ETM+3, ETM+5.
- ETM+4, ETM+5, ETM+2.

Wetland boundaries were digitised directly off screen using these enhancements and displays. The 4/7, 4/3, 4/2 (NIR/SWIR2, NIR/red, NIR/green) combination captured most of the wetlands, but when the above technique failed to distinguish wetlands from other land cover classes, other combinations were scanned to digitize any missing wetlands. Other criteria such as the SRTM slope threshold was used to add wetlands that were missing from combinations displayed above.

The main image used is a dry season scene dated 02 Feb. 2001. Additional imagery is needed to complete the analysis for the northern part of the Dembia Plain and the eastern part of the Fogera Plain, below the 1820 m contour.

The map also needs ground truthing, but is a good first approximation.

The GIS shapefiles will be provided to MoWR and are available on application to the Ministry through the usual channels.

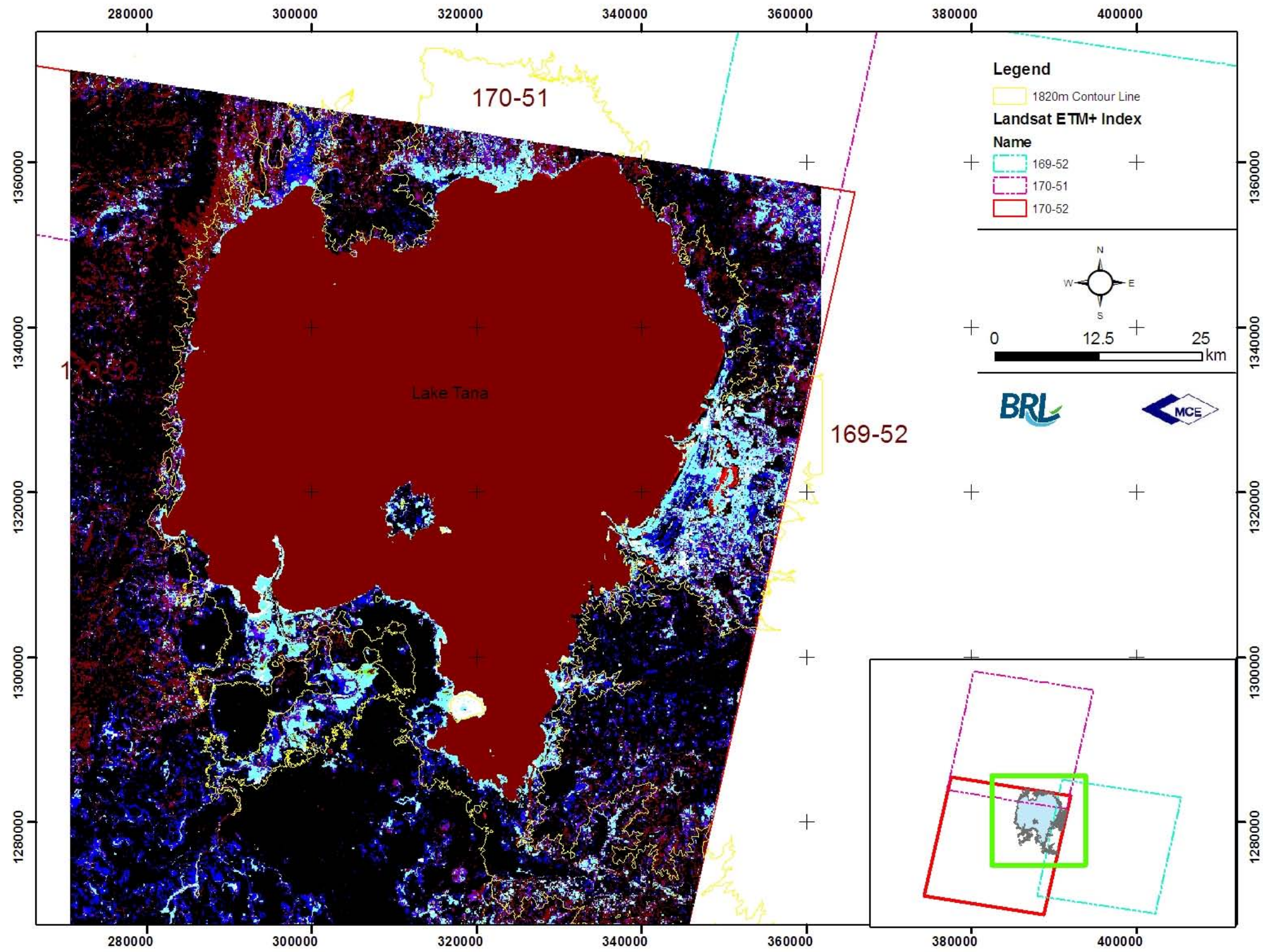
Notes:

TM:Landsat Thematic Mapper

ETM+:Landsat Enhanced Thematic Mapper

SRTM:Shuttle Radar Topography Mission

Map 1.4: Multi-Spectral Satellite Image of Lake Tana showing Wetlands

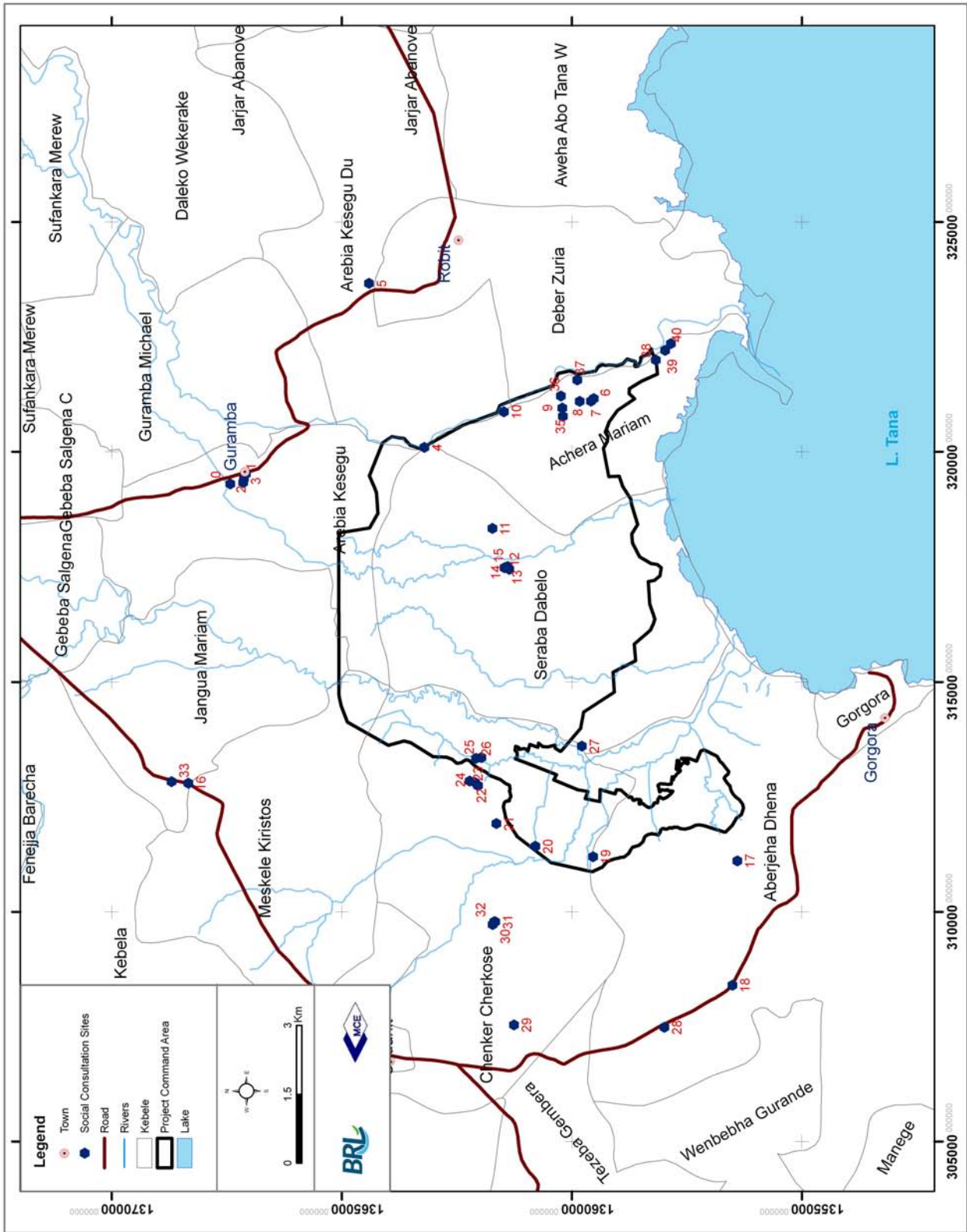








# 1.6 MAP 6: SITES OF SOCIAL CONSULTATION AND OTHER FEATURES

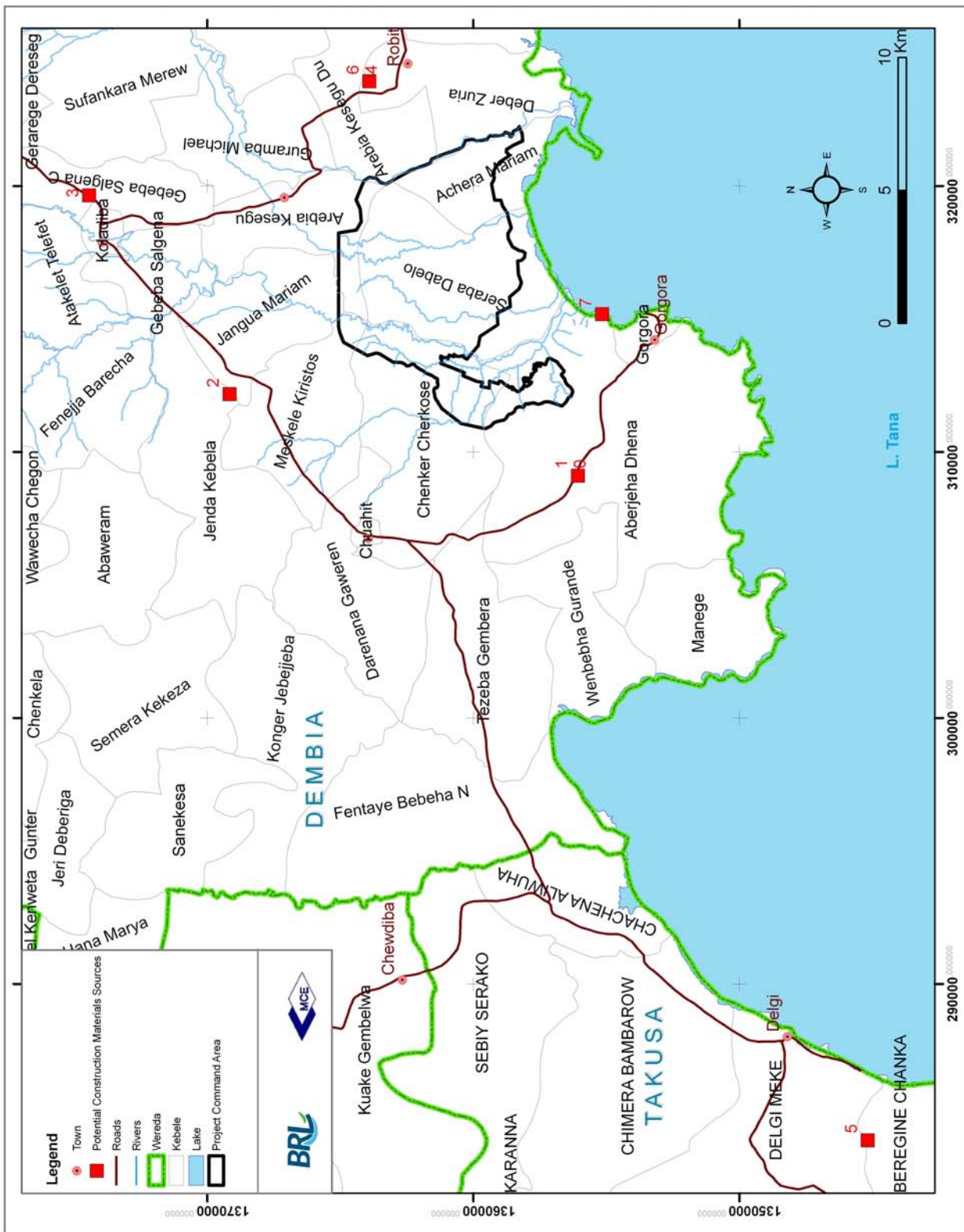


Index on following page.

**Index to Map 6**

Ref.	Kebele	GPS_Coord	GPS_Coord_2	Comment
0	Guramba Bata	319304.00	1367551.00	Northern limit of Guramba village
1	Guramba Bata	319524.00	1367214.00	Southern limit of Guramba village
2	Guramba Bata	319335.00	1367274.00	Guramba Elementary School [1-8]
3	Guramba Bata	319419.00	1367256.00	Guramba Bata Health Centre
4	Guramba Bata	320098.00	1363336.00	Old Megech River bed
5	Deber Zuria	323666.00	1364537.00	New Megech riverbed (right bank)
6	Achera Mariam	321162.00	1359651.00	Health Centre at Kaha
7	Achera Mariam	321106.00	1359712.00	Farmer Training Centre at Kaha
8	Achera Mariam	321099.00	1359956.00	Grinding motors
9	Achera Mariam	320954.00	1360338.00	Hand dug well
10	Achera Mariam	320872.00	1361605.00	Old Megech River bed
11	Seraba Dabelo	318335.00	1361854.00	Dabelo Mariam (Church)
12	Seraba Dabelo	317504.00	1361519.00	Village "Temboaye"
13	Seraba Dabelo	317447.00	1361489.00	Elementary school [1-8]
14	Seraba Dabelo	317481.00	1361594.00	Health Post
15	Seraba Dabelo	317493.00	1361547.00	Kebele HQ (meeting place)
16	Seraba Dabelo	312799.00	1368467.00	River Tanti Kura
17	Aberjeha	311109.00	1356531.00	Wawa School at Acherge [1-4]
18	Aberjeha	308408.00	1356637.00	Aberjeha Kebele HQ
19	Aberjeha/Chenker	311200.00	1359667.00	Dahana River
20	Chenker Cherkose	311429.00	1360921.00	Ahacha River
21	Chenker Cherkose	311923.00	1361767.00	Chenker Tecele Hamanot (Church)
22	Chenker Cherkose	312748.00	1362168.00	Choa Terrara (limit of the hill)
23	Chenker Cherkose	312817.00	1362232.00	Choa Terrara (top of the hill)
24	Chenker Cherkose	312847.00	1362351.00	Choa Terrara (limit of the hill)
25	Chenker Cherkose	313345.00	1362212.00	Choa T. village: Hand-dug well
26	Chenker Cherkose	313358.00	1362095.00	Gilgel River (dry)
27	Chenker Cherkose	313608.00	1359912.00	Dirma River (inside the bed),
28	Chenker Cherkose	307489.00	1358118.00	Gerarye River
29	Chenker Cherkose	307543.00	1361387.00	Kirkos School [1-4]
30	Chenker Cherkose	309727.00	1361850.00	Tibabo Sege School [1-4]
31	Chenker Cherkose	309788.00	1361794.00	Kebele Police Station
32	Chenker Cherkose	309785.00	1361817.00	Kebele Health Post
33	Juangua Mariam	312837.00	1368831.00	Broken bridge on main gravel road
34	Kola Diba	319091.00	1374033.00	Junction between main road and track to Guramba
35	Achera Mariam	320775.00	1360323.00	Achera Mariam (Church)
36	Achera Mariam	321215.00	1360368.00	Achera School [1-6]
37	Achera Mariam	321564.00	1360008.00	Improved well (cemented)
38	Achera Mariam	322000.00	1358301.00	Ategicha hand-dug well (broken)
39	Achera Mariam	322209.00	1358102.00	Abalign school [1-4]
40	Achera Mariam	322355.00	1357977.00	Abalign village, at the new hand-dug well (under construction)

### 1.7 MAP 7: POSSIBLE SOURCES OF CONSTRUCTION MATERIAL



Index on next page.

**Index to Map 7**

<b>FID</b>	<b>Material_T</b>	<b>Description</b>	<b>Location</b>	<b>Easting</b>	<b>Northing</b>
0	Borrow source 1	Yellowish brown silty clay mixed with decomposed basaltic gravel	4.4 km towards Gondar from Wawa PS junction on Gorgora Gondar road near Abirjiha town	309116	1356194
1	Borrow source 2	Yellowish brown silty clay mixed with weathered basaltic gravel	8.1 km from Kola Diba town towards Gorgora town Rt of CL (10.5 km from Wawa PS junction towards Gondar)	309116	1356194
2	Select source	Brown to reddish brown silty clay mixed with weathered basaltic gravel	6.8 from Kola Diba towards Gorgora offset 1 km Rt of CL	312183	1369291
3	Masonry rock source	Porphyritic basalt	Kola Diba town	319651	1374572
4	Sand source 1	Dark gray medium to fine river sand	Megech River	323944	1364039
5	Sand source 2	Light gray medium to fine river sand	10.5 km from Wawa PS junction towards Gondar and Chuait town offset 45 km towards Delgi town (Mariam Wuha River)	284130	1345295
6	Water source 1	River water	Megech River	323944	1364039
7	Water source 2	Lake water	Lake Tana	315190	1355287

Source: MPIDP Detailed Design Report



## 2. Annex 2 - Persons and Organisations contacted by ESIA Study Team

Note: persons and organisations contacted in relation to, specifically, health issues, pest management and cultural heritage are listed again in the Appendices to the respective Annexes in this volume (Annexes 7, 8, 9).

Name	Position / Affiliation	Contact
<b>DEMBIA WOREDA</b>		
<b>Kola Diba</b>		
Asnakew Adane	Administrator	0918-350-205
Bayeh Aberah	Chair, Woreda Project Implementation Team (WPIT)	
Alemneh Banti	Former Chair, (WPIT) / Secretary of Administration	0583-350-002
Alachew Jegnow	Head, Public Relations and Information	
Sebsebachew Atnafu	Head, Environmental and Land Administration Office / Land Use Planning	0583-350-002
Abebe Zerihun	Senior Expert, Land Administration	
Abebe Andarge	Head, Agriculture & Rural Development Office	
Teshager Melesse	Head, Agriculture & Rural Development Office (in Oct. 2009)	
Wezerite Kelemwork Tessera	Head, Water Resources Dept.	
Belaynesh Negussie	Water Quality Expert, Water Resources Department (Drinking Water)	
Amare Moges	Pump Attendant, Water Resources Department (Drinking Water)	
Nega Ali Yesouf	Senior Expert, Drainage and Irrigation Department	
Teshager Meles	Junior Expert, Irrigation Development	
Esmael Ali	Junior Expert, Irrigation Development	
Nega Ali	Drainage Specialist	
Gobegnew Megbiyaw	Junior Expert, Soil and Water Conservation	
Tigist Atebiyaw	Junior Expert, Crop Production	
Fantahun Workiye	Head, Cooperatives (Fishermen's Cooperative)	
Belaynesh Wondimu	Deputy Fish Expert	
Deresegn Fente	Head, Health Office	0583-350-019
Setotaw Begashaw	Former Head, Health Office	0918-064-919
Yesheharg Tewabe	Head, Women's Affairs	0583-350-018
Getahun Mohamed	Head, Finance and Economy Office	
Getachew Melese	Head, Culture and Tourism Office	0913-236-770
Nesiredin Mohammad	Tourism Development & Promotion Officer	
Berhanu Tayachew	Development Agent	0918-068-063
Chalachew Bayu	Development Agent	
<i>Names of Diocese contacts can be obtained from Getachew Melese or Nesiredin Mohammad</i>	Bete Kihnet (Diocese) Office	
<b>Chuahit</b>		
Tabor Mengistu	Supervisor, Health Centre	
<i>Names available</i>	20 women, selling at market	
<b>Gorgora</b>		
Sr. Adina Alemu	Head, Health Centre	
Amsale Eshete	Health Assistant, Gorgora Health Post	
Genanaw	Owner, Wawa Horticultural Farm	058-111-0097 058-231-0739



Name	Position / Affiliation	Contact
Amsalu Retta	General Manager, Wawa Horticultural Farm	058-111-0097 058-231-0739
Ewasu Embiale	Guard, Wawa Horticultural Farm	
Abebe Worku	Guard, Wawa Horticultural Farm	
Gashaw Beza Degu	Manager, Gorgora Port Hotel (informant on hippopotamus)	
Yeshiwas Abera	Chairman, Gorgora Fisheries Cooperative	
Melaku Abate	Treasurer, Gorgora Fisheries Cooperative, and boat owner	
Chekole Metaligne	Member, Gorgora Fisheries Cooperative	
Gebre Azage	Member, Gorgora Fisheries Cooperative	
Gelish Wudu	Member, Gorgora Fisheries Cooperative	
Getnet Berhanu	Member, Gorgora Fisheries Cooperative	
Moges Tesfe	Member, Gorgora Fisheries Cooperative	
Adela Shiferaw	Fisherman	
Habtu Menkir	Fisherman	
Taye Asfaw	Fisherman	
Tim & Kim Otte-de-Hoop	Managers, Tim & Kim Village Campsite / community based project	
Bazen Zerihun	Student, Guide	
Endashaw Setegn	Guide	
Merigeta Wolde Hawariat Zewdie	Cleric, Wawa Kidane Mihret Church (near Chehaldibi)	
Mengaw Tassew	Farmer	
Ayehu Mesfin	Farmer	
<b>Guramba Bata</b>		
Mekonnen Yirdaw	Priest, Guramba Bata Church	
Bahru Belachew	Deacon, Guramba Bata Church	
Getie Getnet	Head, Guramba Health Centre	
Beniam Abebe	Head Nurse	
Abiyut Zezo	Midwifery Nurse	
Nigussie Memberu	Teacher, Guramba Elementary School	
<i>Names available</i>	2 Grade 6 students	
<i>Names available</i>	9 women, Guramba Bata	
Mulu Haile Mariam	Elder	
Yayu Ayele	Farmer	
Tigab Baylegn	Farmer	
Asefa Takele	Farmer	
<b>Achera Mariam</b>		
Mulualem Atnafu	Development Agent	
Berhanu Wondem	Development Agent	
Andebet Sechu	Development Agent	
Akale Alelign	Health Officer	
Abebe Sergaw	Lead farmer	
<i>Names available</i>	15 farmers (men) at Kaha	
<i>Names available</i>	14 women at Kaha	
<i>Names available</i>	4 landless women at Abalign	
<i>Names available</i>	5 farmers and fishermen at Abalign	
<b>Seraba Dabelo</b>		
Belainesh Worku	Kebele Head	
Asnako Yirdew	Kebele Administrator	
Mesafint Seteign	Kebele Administrator	
Mekonen Dersaw	Priest	
Mengesha Admuz	Priest	
Wolde Ube	Priest	

Name	Position / Affiliation	Contact
Mekonen Balatchew	Priest	
<i>Names available</i>	15 farmers, including some members of Seraba Dabelo Multipurpose Primary Cooperative	
<i>Names available</i>	6 students and teachers, Tembohay Elementary School	
<i>Names available</i>	15 women from Woyenit Gote	
<b>Aberjeha Dhena</b>		
Yayu Dahle	Kebele Chairman	
Gehetu Zeleke	Kebele Sub-officer	
Gizat Mengiste	Kebele Sub-officer	
Asmara Bekele	Director, Acherge School, Wawa	
<i>Names available</i>	9 farmers, inc. some members of Aberjeha Multipurpose Primary Cooperative	
<i>Names available</i>	6 women from Acherge	
<i>Names available</i>	3 women (fetching water from dry bed of Awakra River)	
<i>Names not recorded</i>	Various youth, fishing	
<b>Chenker Cherkose</b>		
Melak Ashagne	Priest, Choa Terrara	
<i>Names available</i>	11 farmers	
<b>Meskele Kiristos</b>		
Alebachew Yazew	Elder	
<b>GONDER</b>		
Getnet	Heritage Restoration & Tourism Development Process Owner	0918-703-973
Tamirat Belay	Tourist Service Provider Inspection Officer	
<b>BAHIR DAR</b>		
<b>Bureau of Culture, Tourism and Parks Development (BoCTPD)</b>		
Mulugeta Seid Damtew	Head, BoCTPD and ENIDP Regional Project Coordinator	0918-340-179
Semagn W/Gabriel	Deputy Head, Bureau of Culture & Tourism, & Monitoring and Evaluation Specialist	0918-723-436
<b>Bureau of Finance and Economic Development (BoFED)</b>		
Berhanu Yiachew	ENIDP Deputy Regional Project Coordinator	0918-761-428
Zelalem Gebeyeh	Statistics Officer	
<b>Bureau of Environmental Protection, Land Administration and Use (BoEPLAU)</b>		
Kebede Yima Dawud	Head, BoEPLAU	0918-340-129
Yitayal Abebe Ashot	Ensuring Sustainable Environmental Protection Process Leader	0918-707-172
Getnet Huneguahu	EIA Report Review & Auditing & Monitoring Expert	0918-017-382
Admassu Molla	Former Head, EPLAU	
Bayeh Tiruneh	Head, Land Administration Process	0918-707-172
Gebeyehu Belay	Land Administration Expert	0582-265-483 0918-028-242
Wolde Gebre Kidan	former Ecologist (now PhD student)	0918-780-444
<b>Bureau of Water Resources Development (BoWRD)</b>		
Sesay Asres	Head, Irrigation Dept.	0918-026-533
Sewnet Eshetu	Deputy Head, Irrigation & Drainage SDC Process and Focal Person, ENIDP	0918-768-474
Dagnent Fenta	Water Supply Core Process Owner	0918-018-620
Geteneh Kassahun	Water Quality Expert	0918-765-936
Tesfaye Mengistu	Irrigation Agronomist	
Tesfaye	Socio-economist	
Tsehayu	WUA Promotion Expert	
<b>Koga Irrigation Project</b>		
Sisay Ch'ane	Project Coordinator, Project Management Unit	0918-708-384
Chris Hall	former Resident Engineer, Mott MacDonald	

Name	Position / Affiliation	Contact
<b>Bureau of Agriculture and Rural Development (BoARD)</b>		
Tenaw Ejigu	Irrigated Agriculture Development Process Owner, & ENIDP Component 2 Focal Person	0918-705-114
Bitew Melese	Agricultural Extension Service Process Owner	0918-719-789
Alehegne Dagnew	Head, Project Coordination Office (PSNP / SLMP / TBIWRDP)	0918-707-256
Mehretu Dagnew	Land Valuation and Resettlement Alternatives Preparation Expert	
Muluken Azmeraw	Socio-economist	
Dr. Yienew G. Selassie	Director, Soil & Water Conservation, Amhara Region	
Chalachew Aragaw Zeleke	Fisheries Expert	0918-704-810
Ayehew Zerihun	Head, Plant Health Clinic	0918-013-093
Mandefro Aslake	Former Head, Plant Health Clinic	058-220-0956, 0918-768-996
Dr. Nuria Yideg	Head, Animal Health Laboratory	0918-761-186 0582-800-017
Dr. Solomon	former Head, Animal Health Laboratory	
<b>Amhara Regional Agricultural Research Institute (ARARI)</b>		
Dr. Fantahun Turuneh	Head	
Dr. Birru Yitafaru	Director, Soil and Water Research	0918-160-775
Dr. Gizaw Desta	Senior Researcher	0912-860-328
<b>Tana Beles Integrated Watershed Management Project (TBIWRDP)</b>		
Mikaela Kruskopf	Water Resources Monitoring Advisor	0911-813-342
Getie Asfaw	M&E Advisor	0911-303-686
<b>Bureau of Health (BoH)</b>		
Dr. Asrat Genet	Head	0918-340-523 0582-200-922
Mulusew Lijalem Belew	Deputy Head	0918-707-621 0582-201-438
Dr. Ali Gebeyehu	former Deputy Head	0918-340-914
Dagnew Aweke	Waste Management & Pollution Control Officer	0918-702-820
Andualem Anteneh	Water Quality Control Officer	0911-865-239
Gebrie Birara	Food & Drinks Establishments & Other Institutions Sanitation Officer	0918-022-403
Mengistayehu Berhanu	Waste Management & Environmental Pollution Control Officer	0911-886-305
Fekadu Sedeta	HIV/AIDS Prevention Officer	0918-701-115
Yimenu Adane Mulluneh	Water Pollution Control Officer	0918-700-228
<b>Amhara Regional Infectious Disease and Surveillance Project (AmRIDS)</b>		
Dr. Noboyuki Matsubayashi	Chief Advisor, AmRIDS	058-226-5076
Shuji Noda	Coordinator	0918-020-725
<b>Park Protection and Development Authority (now part of BoCTPD)</b>		
Berhanu Gebre	General Manager	0918-340-139
Dr. B.K. Basaznew	Veterinarian	
Bisrat Kebede		
<b>Bahir Dar Fish and Aquatic Life Research Centre (BFALRC)</b>		
Alayu Yalew	Director	0911-009-212
Dr. Eshete Dejen	Senior Fish Expert	0910-179-094
Mihret Endalew	Senior Fish Expert	
Belay Abdissa	Fish Expert	
Goraw Goshu	Limnology Expert	
<b>Bureau of Women, Children and Youth Affairs (BoWCYA)</b>		
Anteneh Demelash	Gender Mainstreaming Performer	

Name	Position / Affiliation	Contact
Damte Gashu	Women's Associations & Development Work Process Performer	0910-120-043
<b>Bahir Dar University</b>		
Wassie Anteneh	Fish Biologist	
Dr. Amy Collick	Coordinator, Cornell University - Bahir Dar University Watershed Research Programme	0913-321-709
<b>ORDA</b>		
Dagnachew	Programme Advisor	0582-200-266
Ewnetu	Head, Water Resources Dept.	0918-765-938
<b>GTZ</b>		
Dr. Ernst Mill	GTZ SLM Regional Manager	0918-707-666
Dr. Zerfu Hailu	Project Consultant (Sustainable Land Management)	0918-340-086
Alemtshay Kebede	Energy Advisor, Energy Coordination Office, Energizing Development Program	0911-802-485
<b>JICA</b>		
Dr. Hikasa Motoyoshi	Deputy Team Leader, Jica/Amhara Livelihood Improvement Study	0582-181086
<b>Ethiopian Wildlife and Natural History Society (EWNHS)</b>		
Shimeles Aynalem	EWNHS Specialist (Birds)	0911-706-930
<b>Other</b>		
Degu Addis	Independent consultant on agriculture and rural development	0918-769-048
Werner Schroeder	Ornithologist, German Society for Nature Conservation, Africa Programme Coordinator	
Bernhard Walter	Visiting Ornithologist, Biology Station, Germany	
Zemenu Kiber Temesgen	Guide with local knowledge and contacts	0918-047-731 0913-366-641
<b>ADDIS ABABA</b>		
<b>Ministry of Water and Energy</b>		
Hayalsew Yilma	National Project Coordinator, World Bank financed Ethiopian Nile Irrigation and Drainage Project (ENIDP)	011-683-8506
Bedilu Amare	Environmentalist	011-683-8506
Yohannes Benyam	Environmentalist	
Fekahmed Negash	Project Coordinator, Tana Beles Integrated Water Resources Development Project	
Steve Crerar	Water Resources Management Expert, Tana Beles Integrated Water Resources Development Project	
Yohannes Zerihun	Project Coordinator, GoE-funded irrigation & drainage projects in Abbay Basin	0911-898-046
Nelson Edwards	PPP Specialist, Ethiopia Nile Irrigation & Drainage Project	
David Stiggers	Infrastructure Specialist	0920-345-841
<b>Ministry of Agriculture and Rural Development</b>		
Yitayew Abebe	Natural Resources Division	0911-110-797
<b>Institute of Biodiversity Conservation</b>		
Dr. Solomon Abegaz	Senior Researcher	0911-350-212
<b>Authority for Research and Conservation of Cultural Heritage</b>		
Jara Haile Mariam	Director General	011-515-7630
Ephraim Amare	Director, Cultural Heritage Inventory, Impressions and Standardisation	0911-761-554
Hailu Zelleke	Head of Research	
Kebede Geleta	Archaeologist	0911-445-828
Dr. Kassaye Begashaw	former Director (currently Coordinator, Archaeology Unit, AAU)	
<b>Addis Abeba University</b>		
Dr. Mulugeta Feseha	Dean, College of Development Studies	0911-244-962

Name	Position / Affiliation	Contact
<b>International Water Management Institute</b>		
Dr. Seleshi Bekele Awulachew	Head, East Africa and Nile Basin	0911-039-640
Dr. Matthew McCartney	Senior Researcher	0911-739-711
Tadesse Alemayehu	Graduate student	
Alemayehu H.S.	PhD candidate	
<b>Waterworks Design &amp; Supervision Enterprise</b>		
Getnet Kebede	Project Manager, Four Dams and Three Irrigation Projects, Lake Tana Sub-Basin	011-647-8137
Lemma Zara	Deputy Project Manager, Four Dams and Three Irrigation Projects, Lake Tana Sub-Basin	0911-307-491
<b>Tahal Group - CECE</b>		
Harry Rosenberg	Ethiopia Resident Representative, Tahal Group	011-661-6890
M.K. Goyal	Resident Engineer and Team Leader	011-661-6890
Dr. Alek Alperovits	Former Team Leader	
Alemayehu Mengiste	Deputy Team Leader	011-661-6890
Amit Satya	Irrigation Engineer	
Jonathan Spenser	Agronomist	
Israel Tessema	Agriculturalist	
Moshe Gablinger	Engineer	
Yariv Casif	Surveyor	
Dr. Amakaletch Teferi	Social Scientist	
Gossaye Fanta	Resource Economist	
Tomas	GIS Specialist	
<b>World Bank</b>		
Yves Prévost	Lead Environment Specialist	+1-202-473-2136
Francois Onimus	Senior Irrigation Specialist, Africa Region	+1-202-458-9407
Florence Kondylis	Economist, Africa Impact Evaluation Initiative	
Mridula Singh	Senior Social Development Specialist	
Ian Campbell	Senior Economist and Cultural Resources Specialist	0911-254-179
Badre Lenadri	Irrigation and Water Resources Specialist	0913-385-664
<b>INTERNATIONAL</b>		
Prof. Lawrence Todd	Director, Laboratory of Human Paleocology, Dept. of Anthropology, Colorado State University	+1-307-868-2169
Prof. John Kappelman	Professor, Dept. of Anthropology, University of Texas	+1-970-491-5110
Dr. Osbjorn Pearson	Associate Professor, Dept. of Anthropology, University of New Mexico	+1-505-277-6692

### 3. Annex 3 - ESIA Study Team (MPIDP)

- Project Director & Lead Terrestrial Ecologist Dr. France Marion (BRL, international) replaced 01 June 2010 by Dr. Gilles Pahin
- Team Leader James Ramsay (BRL, international)
- Deputy Team Leader Prof. Shibru Tedla (MCE, national)\*
- Lead Aquatic Ecologist Dr. Abebe Getahun Gubale (BRL, national)\*
- Water Resources Management Specialist Julien Verdonck (BRL, international)
- Hydrologist Dr. Yonas Michael Gebrewubet (MCE, national)
- Soil Scientist Zelealem Sahele Mariam (MCE, national)\*
- Irrigation Engineer Zerihun Belayneh (MCE, national)
- Agronomist/Extension Expert Tibebu Tessema (MCE, national)
- Rural Sociologists Maxime Lachal (BRL, international)\*  
Tesea Tolera (MCE, national)\*
- Public Health Specialist Dr. Pierre Gazin (BRL, international)\*
- Cultural Heritage Specialist Temesgen Burka Bortie (BRL, national)
- GIS Specialist Girma Urgeacha (BRL, national)
- \* Assisted by:
  - Melaku Wondafrash Botanist and plant taxonomist
  - Belay Abdissa Graduate student and fish expert
  - Girma Gebrekidan Soil scientist
  - Mengistu Nigussie Socio-economist
  - Netsanet Belay Gender specialist
  - Semira Ahmed Gender specialist
  - Zemenu Kiber Field assistant
  - Solomon Kibret Health assistant (malaria research scientist)



## 4. Annex 4 - Technical Material

### 4.1 WATER QUALITY DATA

The following table lists water quality data as presented in the MPIDP FS (Chapter E, Table E.3-2).

Results of Surface and Groundwater Laboratory Analysis								
Water Quality Parameters	DW Guramba	DW Robit	DW Kurtit	DW Mehal weynet	Spring Demeney	BH Kolla Diba	Megech River	Lake Tana
Date of sampling	17-04-08	17-04-08	17-04-08	19-04-08	18-04-08	20-04-08	21-04-08	19-04-08
pH	7.7	7.5	7.7	7.6	7.7	7.5	8.2	8.5
Electrical conductivity, EC ( $\mu\text{S}/\text{cm}$ )	820	3180	2320	4190	434	860	500	168
Total dissolved solids, TDS (mg/l)	260	1040	820	2940	200	120	200	100
Calcium, Ca (mg/l)	2.515	7.141	6.841	15.045	2.749	1.981	2.246	1.183
Magnesium, Mg (mg/l)	2.959	4.329	6.124	17.837	1.315	1.636	1.94	0.436
Potassium, K (mg/l)	0.041	0.1	0.052	0.109	0.013	0.018	0.068	0.055
Sodium, Na (mg/l)	1.392	3.184	1.427	6.547	0.492	0.831	0.639	0.248
Chlorine, Cl (mg/l)	0.338	6.867	3.867	28.06	0.324	0.395	0.381	0.183
Sulphate, $\text{SO}_4$ (mg/l)	0.234	3.728	6.77	4.586	0.252	0.071	0.131	0.111
Bicarbonate, $\text{HCO}_3$ (mg/l)	6.843	5.245	4.615	10.939	3.447	4.046	5.195	1.628
Phosphate, $\text{PO}_4$ (mg/l)	0.49	0.09	0.11	5.76	0.48	0.06	0.8	0.17
Nitrate, $\text{NO}_3$ (mg/l)	0.039	0.44	0.116	0.115	0.41	-	0.03	0.027

DW: drinking water; BH: borehole



## 4.2 LIST OF DOCUMENTS RELATING TO EXISTING AND PLANNED WATER PROJECTS AROUND LAKE TANA

The following table lists some of the many reports relevant to water resources development around Lake Tana.

Author	Year	Title	Comment
<b>ETHIOPIAN NILE IRRIGATION &amp; DRAINAGE PROJECT - ENIDP</b>			
Tahal - MWH - CECE	2006	ENIDP - Consultancy Service for Identification of Irrigation and Drainage Projects in the Nile Basin in Ethiopia - Revised Final Report	July 2006 "Phase 1"
WB	2007	Project Appraisal Document (PAD)	
WB	2007	Env. & Social Management Framework (ESMF)	
WB		Resettlement Policy Framework (RPF)	
Tahal - CECE	2007	Technical Proposal	
Castalia	2008	Public-Private Partnership Options and Action Plan Study	March 2008
Tahal - CECE	2008	Consultancy Services for Feasibility Study, Detail Design and Preparation of Tender Documents of Irrigation & Drainage Projects in the Nile Basin of Ethiopia - Interim Report (draft)	June 2008 Covers Megech, Ribb & Anger
<b>EASTERN NILE IRRIGATION AND DRAINAGE STUDY - ENIDS</b>			
BRL	2008	Component 1 - Phase 1: Diagnostic and Planning Phase (draft)	June 2008
BRL - MCE - Shoraconsult	2008	Component 1 - Phase 1: Diagnostic and Planning Phase' (final)	
BRL	2008	Component 2 - Phase 2: Analysis (draft)	June 2008
<b>LAKE TANA SUB-BASIN FOUR DAMS PROJECT</b>			
<b>Megech Dam</b>			
WWD&SE - Tahal	2007	Megech Dam Project - Final Feasibility Report - Vol. VII - EIA Report (draft)	Oct. 2007
WWD&SE - Tahal	2007	Megech Dam Project - Final Feasibility Report - Vol. VIII - Watershed Management Study Report (draft)	Oct. 2007
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. I - Dam Planning	Jan. 2008
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. II - Geological and Geotechnical Investigation	Jan. 2008
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. III - Hydrological Investigations	Jan. 2008
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. IV - Design Criteria for Dams and Appurtenant Structures	Jan. 2008
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. V - Album of Drawings	Jan. 2008
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. VI - Socio-economic Study & Resettlement Plan	April 2008 (2 files)
WWD&SE - Tahal	2008	Megech Dam Project - Final Feasibility Report - Vol. VIII - Watershed Management Plan	April 2008
<b>Ribb Dam</b>			
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. I - Dam Planning Report - draft	April 2007
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. II - Geological Report ("Ribb Dam Investigation - Interim Report")	April 2007
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. III - Hydrological Report (draft final)	May 2007
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. III - Hydrological Investigations	August 2007
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. IV - Design Criteria	April 2007
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. V - Drawings	April 2007
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. VI - Socio-economic Study & Resettlement Plan	Oct. 2007 2 files
WWD&SE - Tahal	2007	Ribb Dam Design - FS - Vol. VII - EIA	Oct. 2007 Unacceptable to WB
WWD&SE - Tahal	2008	Ribb Dam Design - FS - Vol. VIII - Watershed Management Study	Jan. 2008

Author	Year	Title	Comment
Burnside - Tonkin & Taylor	2009	ESIA for the Ribb Dam, Final Report	May 2009
Beza Consulting Eng.	2010	Task Two Report for Preparation of a Resettlement Action Plan, Ribb Dam Project	Feb 2010
<b>Jema Dam</b>			
WWD&SE - Tahal	2007	Jema Dam Project - Draft Feasibility Report - Vol. VII - Environmental Impact Assessment	October 2007
WWD&SE - Tahal	2008	Jema Dam Project, Draft Feasibility Report - Vol. VII - Environmental Impact Assessment	April 2008
WWD&SE - Tahal	2008	Jema Dam Project - Draft Feasibility Report - Vol. VI - Socio-economic Study and Resettlement Planning Report	April 2008
WWD&SE - Tahal	2008	Jema Dam & Irrigation Design Project - Final Feasibility Report - Socio-economic Study and Resettlement Planning	August 2008
WWD&SE - Tahal	2008	Jema Dam Project - Draft Feasibility Report - Vol. VIII - Watershed Management Plan	April 2008
WWD&SE - Tahal	2008	Jemma Dam Project - Feasibility Report - Vol One - Planning Report	July 2008
WWD&SE - Tahal	2008	Jemma Dam Project - Feasibility Report - Vol Two - Geological and Geotechnical Investigations Report	July 2008
WWD&SE - Tahal	2008	Jemma Dam Project - Feasibility Report - Vol Three - Hydrological Investigations	April 2008
WWD&SE - Tahal	2008	Jemma Dam Project - Feasibility Report - Vol Four - Design Criteria	July 2008
WWD&SE - Tahal	2008	Jemma Dam Project - Feasibility Report - Vol Five - Album of Drawings	July 2008
<b>Gilgel Abbay Dam</b>			
WWD&SE - Tahal	2008	Gilgel Abbay Dam & Irrigation Design Project: Final Feasibility Report - Socio-economic Study & Resettlement Planning	August 2008
<b>MEGECH PUMP (Seraba)</b>			
MoWR	2008	TOR - Resettlement Action Plan (Megech (at Seraba) and Ribb Irrigation Schemes)	
Tahal - CECE	2008	Megech Pump I&D Project - Inception Report	March 2008
Tahal - CECE	2008	Megech Pump I&D Project - Monthly Reports 1 - 12	
Tahal - CECE	2008	Megech Pump I&D Project - Agricultural Development Report (draft)	Sep. 2008
Tahal - CECE	2008	Megech Pump I&D Project - Environmental Baseline Study Report	Dec. 2008
Tahal - CECE	2008	Megech Pump I&D Project - Hydrology (draft)	Nov. 2008
Tahal - CECE	2008	Megech Pump I&D Project - Hydrogeology (draft)	Nov. 2008
Tahal - CECE	2008	Megech Pump I&D Project - Soils & Land Suitability (draft)	Nov. 2008
Tahal - CECE	2008	Megech Pump I&D Project - Basic Principles for the Irrigation System (draft)	
Tahal - CECE	2009	Megech Pump I&D Project - Socioeconomic & WUA Study Report - Part One (draft)	Feb. 2009
Tahal - CECE	2009	Megech Pump I&D Project - Socioeconomic & WUA Study Report - Part Two (draft)	Feb. 2009
Tahal - CECE	2010	Megech Pump I&D Project - Final Feasibility Study (3 volumes)	Feb. 2010
SMEC	2010	Resettlement Action Plan (draft)	Aug. 2010
Tahal - CECE	2010	Megech Pump I&D Project - Detailed Design Report and Farmers Mobilization and Consultation Report	July 2010
Tahal - CECE	2010	Megech Pump I&D Project - draft Bidding (Tender) Documents	Oct. 2010
<b>MEGECH PUMP (Robit)</b>			
Halcrow - GIRD	2010	Megech Pump (Robit) Project - Draft Feasibility Study Report (D3): main report and supporting volumes	May 2010
<b>RIBB - IRRIGATION &amp; OTHER</b>			
Halcrow - MCE	2007	ENTRO - Integrated Watershed Management (Ethiopia) - Watershed Project, Fast-Track Project - Detailed Project Preparation - Project Implementation Plan - Volume 1 - Main Report (and all other project reports)	Dec. 2007

Author	Year	Title	Comment
Halcrow - MCE	2007	ENTRO - Integrated Watershed Management (Ethiopia) - Watershed Project, Fast-Track Project - Detailed Project Preparation - Project Implementation Plan - Volume 3 - Annex F - Social & Environmental Assessment	Dec. 2007
Abebe at al.	2008	Fishery Studies of the Ribb River, Lake Tana Basin, Ethiopia - Final Report	Jan. 2008 Scanned doc.
MoWR	2008	TOR - Resettlement Action Plan (Megech (at Seraba) and Ribb Irrigation Schemes)	
Tahal - CECE	2008	Ribb Irrigation & Drainage Project - Inception Report	March 2008
Tahal - CECE	2008	Ribb Irrigation & Drainage Project - Monthly Reports 1 - 12	
Tahal - CECE	2008	Ribb Irrigation & Drainage Project - Agricultural Development Report (draft)	Sep. 2008
Tahal - CECE	2008	Ribb Irrigation & Drainage Project - Hydrology (draft)	Nov. 2008
Tahal - CECE	2008	Ribb Irrigation & Drainage Project - Hydrogeology (draft)	Nov. 2008
Tahal - CECE	2008	Ribb Irrigation & Drainage Project - Environmental Baseline Study Report - Unrevised Draft Report	Dec. 2008
Tahal - CECE	2009	Ribb Irrigation & Drainage Project - Environmental Baseline Study Report	Jan. 2009
Eshete Dejen	2010	Interim Report for Preparation of Detailed Implementation Manual for Environmental & Social Management Plan of Ribb River on Fish Resources (draft)	Sep. 2010
Tahal - CECE	2010	Ribb Irrigation & Drainage Project - Final Feasibility Study	Sep. 2010
<b>GUMERA</b>			
WWD&SE - Intercontinental	2006	Gumera Irrigation Project - Catchment Development Plan	Sep. 2006
WWD&SE - Intercontinental	2008	Gumera Irrigation Project - Feasibility Study - Executive Summary - draft final	Feb. 2008
WWD&SE - Intercontinental	2008	Gumera Irrigation Project - Feasibility Study - Main Report - draft final	Feb. 2008
<b>KOGA</b>			
Acres Int. & Shawel Consult Int.	1995	Koga Irrigation Project - Feasibility Study - Main Report	Mar 1995
Mott MacDonald	2005	Koga Irrigation Project, Working Paper No. 13: Implementation and Operation - Issues of Concern	Dec. 2005
Wubneh Belete Abebe	2007	EIA implementation and follow-up: A case study on Koga irrigation project-Ethiopia	pdf of Powerpoint file
Desta Horecha Water Supply Engineering Service	2007	Irrigation Water Pricing and Cost Recovery System for Koga Irrigation Project - Draft Final Report - Vol. I - Main Report	Sep. 2007 scan
Wubneh Belete Abebe <i>et al.</i>	2008	EIA Follow-Up in the Koga Irrigation Project, Ethiopia. Proc. of 2nd Int. Forum on Water and Food (Addis Ababa 9-14 Nov., 2008) Vol II: 52-55	
Ayalew Gebre, Derese Getachew and M. McCartney	2008	Stakeholder Analysis of the Koga Irrigation and Watershed Management Project (for IWMI)	Jan. 2008
<b>TANA-BELES HYDROLOGY</b>			
MoWR	2005	Tana - Beles Water Systems - An Overview of Water Resources, Development Potentials and Issues	
SMEC	2007	Hydrological Study of the Tana-Beles Sub-Basins - Monthly Report No. 1	June 2007
SMEC	2007	Hydrological Study of the Tana-Beles Sub-Basins - Draft Inception Report	July 2007
SMEC	2008	Hydrological Study of the Tana-Beles Sub-Basins - Main Report	May 2008
SMEC	2008	Hydrological Study of the Tana-Beles Sub-Basins - Financial and Economic Analyses	May 2008
SMEC	2008	Hydrological Study of the Tana-Beles Sub-Basins - Groundwater Investigation	May 2008

Author	Year	Title	Comment
SMEC	2008	Hydrological Study of the Tana-Beles Sub-Basins - Hydrological Monitoring Network (Review and Recommendations)	
SMEC	2008	Hydrological Study of the Tana-Beles Sub-Basins - Surface Water Investigation	May 2008
SMEC	2008	Hydrological Study of the Tana-Beles Sub-Basins - Ecological Study with Emphasis on Biological Resources	May 2008
<b>TANA &amp; BELES INTEGRATED WATER RESOURCES DEVELOPMENT PROJECT (TBIWRDP)</b>			
WB	2006	TBIWRDP - Project Information Document (PID) - Concept Stage	
WB	2008	TBIWRDP - Project Appraisal Document (PAD)	
MoWR	2008	TBIWRDP - ESMF and RPF - Final Report	
MoWR	2008	TBIWRDP - Project Implementation Manual (PIM) - Final	
BRL	2008	TBIWRDP - Institutional & Capacity Building Studies - Final Report	
various	2008	TBIWRDP - Project Launch Workshop, Bahir Dar - presentations	ppt
WB	2008	Project Launch Mission - Aide Memoire	Nov. 2008
<b>TANA-BELES HYDROPOWER</b>			
Lahmeyer-Electrowatt-Knight Piesold (LEK)	2000	Feasibility Study of Beles Hydropower Project - Main Report	August 2000
LEK	2000	Feasibility Study of Beles Hydropower Project - EIA	
?	?	Feasibility Study of Beles and Chemoga-Yeda Stage 1 Hydropower Project - Report on International Water Rights Implications	
<b>LAKE TANA - OTHER</b>			
David Barker	2004	Address to Lake Tana Symposium, Bahir Dar	LakeNet President
McCartney et al.	2008	Estimating Environmental Flow Requirements downstream of the Chara Chara weir on the Blue Nile river	June 2008
Ayalew Gebre et al.	2008	Stakeholder Analysis of the Chara Chara Weir, Lake Tana (IWMI)	Jan. 2008
<b>ABBAY BASIN</b>			
Abbay Basin Study	1998	Abbay Master Plan - numerous volumes	
BRL - DHV - T&A	2005	Institutional Set-up Studies of the Ethiopian Nile (Abbay) Basin Project - Institutional Study Phase - Executive Summary	April 2005
BRL - DHV - T&A	2005	Institutional Set-up Studies of the Ethiopian Nile (Abbay) Basin Project - Institutional Study Phase - Report No. 1 - Final Institutional Proposal for the Creation of the Abbay River Basin Organisation	May 2005 July 2005
BRL - DHV - T&A	2005	Institutional Set-up Studies of the Ethiopian Nile (Abbay) Basin Project - Institutional Study Phase - Report No. 2 - Planning, M&E and MIS Strategy	May 2005 July 2005
BRL - DHV - T&A	2005	Institutional Set-up Studies of the Ethiopian Nile (Abbay) Basin Project - Draft Master Plan Summary and Basin Strategic Planning and Management	no cover page
<b>NILE BASIN</b>			
ENTRO		Irrigation and Drainage Study in the Blue Nile Basin	
<b>SUSTAINABLE LAND MANAGEMENT (SLM) PROJECT</b>			
MoARD / WB	2007	SLM - Environmental and Social Management Framework (draft)	
WB	2008	SLM PAD	
TerrAfrica	?	TerrAfrica: Regional Sustainable Land Management	
<b>CLIMATE CHANGE</b>			
Paul Block	2008	An Assessment of Investments in Agricultural and Transportation Infrastructure, Energy, and Hydroclimatic Forecasting to Mitigate the Effects of Hydrologic Variability in Ethiopia	CGIAR CPWF Working Paper 1

Author	Year	Title	Comment
Block et al.	2008	Integrated Management of the Blue Nile Basin in Ethiopia under Climate Variability and Climate Change Hydropower and Irrigation Modelling	IFPRI Research Brief 15-14
Kim & Kaluarachchi	2008	Analysis of Hydrology and Water Resources of the Upper Blue Nile River Basin under Climate Change	Nile Regional Workshop, June
Jaap Kwadijk	?	Climate, water supply, management and use in the Nile, a comparison	
Giday Wolde Gabriel	?	Significance of Past Climatic Records in Terrestrial Sediments for Assessing Current and Future Conditions	
<b>TRANSBOUNDARY</b>			
NBI	2001	Transboundary Environmental Analysis	May 2001

### 4.3 ARARI RESEARCH PROJECTS PLANNED FOR 2010 - 2011 FOR ENIDP

#### Amhara Region Agricultural Research Institute (ARARI)

##### List of research project activities planned for 2010/11 for NIDP

SN	Project activity	Scheme	Status	Implementing Center	Duration
1	Rate Determination of Inorganic Fertilizer for Onion and Tomato in Megach and Ribb irrigation schemes	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
2	Adaptability potential evaluation of green manures species for soil amelioration for Megach and Ribb irrigation schemes	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
3	Adaption and promotion of vermicompost preparation technology around Megech and Ribb	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
4	Determination of Irrigation Water Requirements and Schedule of Onion and Tomato around Megech and Ribb	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
5	Rate Determination of Nitrogen and Phosphorus Fertilizer for Garlic, Pepper and Snap bean in Megech and Pepper and Snap bean in Ribb irrigation schemes	Megech & Ribb	New	Gonder, Adet	2 yrs (2011-12)
6	Determination of Irrigation Water Requirements and Schedule of Garlic and Pepper around Megech and Ribb	Megech & Ribb	New	Gonder, Adet	2 yrs (2011-12)
7	Development of crop suitability classification of Ribb and Megech irrigated area	Megech & Ribb	New	Gonder, Adet	2 yrs (2011-12)
8	Validating CROPWAT model around Megech	Megech	New	Gonder	1 yr (2011)
9	Demonstration of Mobile nursery using root trainer and Bamboo box as off-farm income generation for poor woman in the Megech and Ribb catchment area	Megech & Ribb	Ongoing	Gonder, Adet	1 yr
10	Selection of different trees/shrubs species for upper catchment treatment of Megech and Ribb watersheds	Megech & Ribb	New	Gonder, Adet	5 yrs
11	Participatory Evaluation of multistory homestead agroforestry practice for multiple production and sustainable land management around Megech and Ribb catchment area	Megech & Ribb	New	Gonder, Adet	4 yrs
12	Promotion of hybrid tomato variety under irrigation condition	Ribb	Ongoing	Adet	1 yr (2010/11)
13	Participatory evaluation of hybrid tomato variety under irrigation condition	Megech	Ongoing	Gonder	1 yr (2010/11)
14	Promotion of open pollinated tomato varieties / Popularization and seed extraction and home based processing of tomato/ under irrigation condition	Ribb	Ongoing	Adet	1 yr (2010/11)
15	Open pollinated tomato variety adaptation trial	Megech	Ongoing	Gonder	2 yrs (2010-11)

16	Participatory snap bean variety evaluation and utilization	Ribb, Koga, Megech	Ongoing	Adet	2 yrs (2010-11)
17	Bread wheat variety adaptation trial under irrigation condition	Ribb and Megech	Ongoing	Adet, Gonder	2 yrs (2010-11)
18	Black cumin variety adaptation trial and determination of amount and frequency of water requirement under irrigation condition	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
19	Effect of plant population and irrigation frequency on the yield of tomato	Ribb	Ongoing	Adet	2 yrs (2010-11)
20	Promotion of Haricot bean under irrigation condition	Ribb	Ongoing	Adet	2 yrs (2010-11)
21	Participatory evaluation of improved chickpea variety adaptation	Megech	Ongoing	Gonder	2 yrs (2010-11)
22	Establishing FREG at Ribb and Megech under irrigation condition	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
23	Assessment of spatial and temporal crop pest distribution and prevalence under irrigation condition	Megech & Ribb	Ongoing	Gonder, Adet	2 yrs (2010-11)
24	Maize variety adaptation trial under irrigation condition	Megech & Ribb	New	Gonder, Adet	2 yrs (2011-12)
25	Assessment of cropping sequence and enterprise choice of major crops in irrigated agriculture at Megech and Rib	Megech & Ribb	New	Gonder, Adet	2 yrs (2011-12)
26	Identification of staggered planting for tomato and onion under irrigation condition	Ribb	New	Adet	2 yrs (2011-12)
27	Evaluation of commercial vegetables under irrigation (cabbage, carrot, beetroot) and Pop corn, cucumber, eggplant, cauliflower for Woramit	Ribb, Megech, Koga and Woramit	New	Gonder, Adet	2 yrs (2011-12)
28	Demonstration of hybrid onion variety under irrigation	Ribb, Koga	New	Adet	2 yrs (2011-12)
29	Effect of deficit irrigation and nitrogen fertilizer on the yield and yield related components of upland rice in fogera	Ribb	New	Adet	
30	Water productivity and irrigation scheduling for potato production in North Gondar Zone, Ethiopia	Megech	New	Gonder	
31	Adaptability Evaluation of Different Napier Grass ( <i>Pennisetum purpureum</i> ) Accessions Around Megech in North Gondar	Megech	Ongoing	Gonder	
32	Evaluation of the performance of herbaceous legumes under sown with maize in Megech and Rib Rivers watershed areas	Megech & Ribb	Ongoing	Gonder, Andassa	
33	Adaptation of different Annual and Perennial Forage Crops at	Megech & Ribb	Ongoing	Gonder,	

	Megech and Rib River catchment areas			Andassa	
34	Reclamation of weed invaded communal pastures at Rib River watershed area of Lake Tana	Ribb	Ongoing	Andassa	
35	Evaluation and Demonstration of the practice of forage planting at the edges of irrigation canals and farm boundaries	Megech & Ribb	Ongoing	Gonder, Andassa	
36	Demonstration of integrated fish-rice production in the Fogera areas	Fogera	Ongoing	BD Fishery	
37	Demonstration of hatchery rearing and evaluation of reared fish fingerlings for farming & enhancement of dams/reservoirs; case of Megech and Rib	Megech & Ribb	Ongoing	BD Fishery	
38	On-station evaluation of urea treated rice straw and feed supplements on the fattening performance of oxen in Fogera Woreda	Fogera (Ribb)	New	Andassa	
39	Performance evaluation of Fogera and Holstien Fresian dairy Cows under Urea Molasses Mineral Block Supplementation	Fogera	New	Andassa	
40	On-farm demonstration of Solar Tent Fish Drying Technology in Eastern Part of Lake Tana	Eastern Tana	New	BD Fishery	
41	Evaluation and demonstration of rice seeder and weeder around Ribb irrigation scheme	Megech & Ribb	Ongoing	BDAMFS	
42	Evaluation of naturally ventilated bulb onion storage structures in Ribb irrigation scheme	Ribb	Ongoing	BDAMFS	
43	Demonstration of low cost water lifting devices around river Ribb	Ribb	Ongoing	BDAMFS	
44	Testing and demonstration of home processing techniques for onion	Megech & Ribb	Ongoing	BDAMFS	
45	Demonstration of handheld maize sheller and pedal rice thresher in Ribb	Ribb	New	BDAMFS	2 yrs (2010-11)
46	Participatory evaluation and demonstration of engine driven/portable rice dehusker around Ribb	Ribb	New	BDAMFS	2 yrs (2010-11)
47	Perception and determinants of farmers' decision on use of mechanization technologies: the case of Fogera and Koga irrigation areas	Ribb	New	BDAMFS	1 yrs (2010/11)



## 5. Annex 5 - Ecological Data

### 5.1 PLANT SPECIES IN MAIN HABITATS IN STUDY AREA

The following list is based on fieldwork in the project area by the ESIA team's botanist in 2010. The original findings are listed at Annex 5.2.

Local Name	Scientific Name	Family Name	Habitat	Abundance
<b>Lakeshore wetlands</b>				
	<i>Alternanthera sessilis</i> (L.) DC.	AMARANTHACEAE	lakeshore wetlands	xx
	<i>Ceratophyllum submersum</i>	CERATOPHYLLACEAE	lakeshore wetlands	x
	<i>Cyperus sp.</i>	CYPERACEAE	lakeshore wetlands	xxx
Engecha	<i>Cyperus alopecuroides</i> Rottb.	CYPERACEAE	lakeshore wetlands	xxx
	<i>Echinochloa stagnina</i> (Retz.) P. Beauv.	POACEAE	lakeshore wetlands	xxx
Afeshfash	<i>Echinochloa stagnina</i> (Retz.) P. Beauv.	POACEAE	lakeshore wetlands	xxx
	<i>Ipomoea aquatica</i> Forssk.	CONVOLVULACEAE	lakeshore wetlands	x
	<i>Ludwigia abyssinica</i> A. Rich.	ONAGERACEAE	lakeshore wetlands	xxx
	<i>Ludwigia stolonifera</i> (Guill. & Perr.) Raven	ONAGERACEAE	lakeshore wetlands	xxx
	<i>Nymphoides indica</i> (L.) O. Kuntze	POACEAE	lakeshore wetlands	xx
	<i>Panicum subalbidum</i> Kunth.	POACEAE	lakeshore wetlands	xx
	<i>Persicaria setosula</i> (A. Rich) K.L. Wilson	POLYGONACEAE	lakeshore wetlands	xx
	<i>Sphaeranthus suaveolens</i> (Forssk.) DC.	ASTERACEAE	lakeshore wetlands	xx
	<i>Typha latifolia</i> L.	TYPHACEAE	lakeshore wetlands	xx
<b>Seasonally flooded grasslands</b>				
	<i>Alternanthera sessilis</i> (L.) DC.	AMARANTHACEAE	seasonally flooded grasslands	x
	<i>Amaranthus spinosus</i> L.	AMARANTHACEAE	seasonally flooded grasslands	x
Nech Eshoh	<i>Argemone mexicana</i> L.	PAPAVERACEAE	seasonally flooded grasslands	xxx
yaheya Eshoh	<i>Cirsium vulgare</i> (Savi.) Ten.	ASTERACEAE	seasonally flooded grasslands	xxx
	<i>Cynodon dactylon</i>	POACEAE	seasonally flooded grasslands	xxx
	<i>Datura stramonium</i> L.	SOLANACEAE	seasonally flooded grasslands	xx
Awunda	<i>Ethulia gracilis</i> Del.	ASTERACEAE	seasonally flooded grasslands	x
	<i>Evolvulus alsinoides</i> (L.) L.	CONVOLVULACEAE	seasonally flooded grasslands	x
Asendabo	Grass		seasonally flooded grasslands	xx
	<i>Phyla nodiflora</i> (L.) Greene	VERBENACEAE	seasonally flooded grasslands	xx
	<i>Sida alba</i>	MALVACEAE	seasonally flooded grasslands	x
	<i>Trifolium rueppelianum</i> Fresen	FABACEAE	seasonally flooded grasslands	



Local Name	Scientific Name	Family Name	Habitat	Abundance
Maget	<i>Trifolium rueppelianum</i> Fresen	FABACEAE	seasonally flooded grasslands	x
Atuch	<i>Verbena officinalis</i>	VERBENACEAE	seasonally flooded grasslands	xx
	<i>Xanthium spinosum</i> Willd.	ASTERACEAE	seasonally flooded grasslands	xxx
Derge Eshoh	<i>Xanthium strumarium</i> L.	SOLANACEAE	seasonally flooded grasslands	xx

**Grazing land**

	<i>Acacia sp.</i>	FABACEAE	Grazing land	x
	<i>Acacia abyssinica</i> Hochst ex Benth.	FABACEAE	Grazing land	x
	<i>Acacia asak</i> (Forssk.) Willd.	FABACEAE	Grazing land	x
	<i>Acacia seyal</i> Del.	FABACEAE	Grazing land	x
	<i>Dicliptera sp.</i>	ACANTHACEAE	Grazing land	x
Seya	<i>Hibiscus cannabinus</i> L.	MALVACEAE	Grazing land	x
	<i>Indogofera sp.</i>	FABACEAE	Grazing land	x
	<i>Ipomea sp.</i>	CONVOLVULACEAE	Grazing land	x
	<i>Sphaeranthus steetzii</i> Oliv. & Hiern	ASTERACEAE	Grazing land	xx
	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	POLYGONACEAE	Seasonally flooded grasslands	xxx
	<i>Ageratum conyzoides</i> L.	ASTERACEAE	Seasonally flooded grasslands	xx
nechilo	<i>Argemone mexicana</i> L.	PAPAVERACEAE	Seasonally flooded grasslands	xxx
yayit joro	<i>Centella asiatica</i> (L.) Urban	APIACEAE	Seasonally flooded grasslands	xxx
	<i>Cirsium vulgare</i> (Savi.) Ten.	ASTERACEAE	Seasonally flooded grasslands	xxx
	<i>Cyperus sp.</i>	CYPERACEAE	Seasonally flooded grasslands	
	<i>Cyperus rigidifolius</i> Steud.	CYPERACEAE	Seasonally flooded grasslands	xx
	<i>Echinochloa colona</i> (L.) Link	POACEAE	Seasonally flooded grasslands	xx
Afeshfash	<i>Echinocloa stagnina</i>	POACEAE	Seasonally flooded grasslands	xxx
amekela	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	ACANTHACEAE	Seasonally flooded grasslands	xxx
	<i>Ludwigia stolonifera</i> (Guill. & Perr.) Raven	ONAGRACEAE	Seasonally flooded grasslands	xxx
	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	POLYGONACEAE	Seasonally flooded grasslands	xxx
Kurimba	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	ACANTHACEAE	Seasonally flooded grasslands	xxx
	<i>Ludwigia stolonifera</i> (Guill. & Perr.) Raven	ONAGRACEAE	Seasonally flooded grasslands	xxx
Gumamla	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	POLYGONACEAE	Seasonally flooded grasslands	xxx

**Farmland and settlements**

girar	<i>Acacia sp.</i>	FABACEAE	Farmland and settlements	x
	<i>Ageratum conyzoides</i> L.	ASTERACEAE	Farmland and settlements	xx
	<i>Cardiospermum halicacabum</i> L.	SAPINDACEAE	Farmland and settlements	x
papaya	<i>Carica papaya</i> L.	CARICACEAE	Farmland and settlements	x
	<i>Casuarina cunninghamiana</i> Miq.	CASUARINACEAE	Farmland and settlements	x
	<i>Centella asiatica</i> (L.) Urban	APIACEAE	Farmland and settlements	xx

Local Name	Scientific Name	Family Name	Habitat	Abundance
Queen of the night (Eng)	<i>Cestrum nocturnum</i> L.	SOLANACEAE	Farmland and settlements	x
ye hahiya eshoh	<i>Cirsium vulgare</i> (Savi) Ten	ASTERACEAE	Farmland and settlements	xxx
	<i>Crotalaria spinosa</i> Hochst ex Benth.	FABACEAE	Farmland and settlements	x
	<i>Cynodon dactylon</i>	POACEAE	Farmland and settlements	xxx
	<i>Cynoglossum</i> sp.	BORAGINACEAE	Farmland and settlements	x
Dengua/ Engecha	<i>Cyperus</i> sp.	CYPERACEAE	Farmland and settlements	xxx
Guwaro tebaqi	<i>Datura stramonium</i> L.	SOLANACEAE	Farmland and settlements	xx
	<i>Eucalyptus</i> sp.	MYRTACEAE	Farmland and settlements	xxx
bahir zaf	<i>Eucalyptus tereticornis</i> Sm.	MYRTACEAE	Farmland and settlements	x
	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	ACANTHACEAE	Farmland and settlements	xxx
atat	<i>Maytenus gracilipes</i> (Welw. Ex Oliv.) Exell	CELASTERACEAE	Farmland and settlements	x
	<i>Nerium oleander</i> L.	APOCYNACEAE	Farmland and settlements	x
Gumamla	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	POLYGONACEAE	Farmland and settlements	xxx
	<i>Pimpinella</i> sp.	APIACEAE	Farmland and settlements	x
	<i>Plantago lanceolata</i> L.	PLANTAGINACEAE	Farmland and settlements	xx
Qachima	<i>Ricinus communis</i> L.	EUPHORBIACEAE	Farmland and settlements	xx
Serk Abeba	<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	FABACEAE	Farmland and settlements	xxx
	<i>Senna</i> sp.	FABACEAE	Farmland and settlements	x
Gorgegit	<i>Sida alba</i>	MALVACEAE	Farmland and settlements	x
	<i>Solanum incanum</i> L.	SOLANACEAE	Farmland and settlements	x
Amerarit	<i>Sphaeranthus suaveolens</i> (Forssk.) DC.	ASTERACEAE	Farmland and settlements	xx

**Scrub**

girar	<i>Acacia</i> sp.	FABACEAE	scrub	x
	<i>Acanthus sennii</i> Chiov.	ACANTHACEAE	Scrub	xx
	<i>Ageratum conyzoides</i> L.	ASTERACEAE	Scrub	xxx
sesssa	<i>Albizia gummifera</i> (J.F. Gmel) C.A. Sm	FABACEAE	scrub	x
aluma	<i>Amaranthus spinosus</i> L.	AMARANTHACEAE	scrub	xx
gumero	<i>Capparis tomentosa</i> Lam.	CAPPARIDACEAE	Scrub	xx
	<i>Crotalaria incana</i> L.	FABACEAE	Scrub	x
Yemedir Embuway	<i>Cucumis prophetarum</i> L.	CUCURBITACEAE	Scrub	x
	<i>Cynoglossum</i> sp.	BORAGINACEAE	Scrub	x
atse faris	<i>Datura stramonium</i> L.	SOLANACEAE	scrub	xx
	<i>Echinops macrochaetus</i> Fresen	ASTERACEAE	Scrub	xxx
	<i>Eleusine africana</i> Kenn.-O'Byrne	POACEAE	Scrub	x
korcch	<i>Erythrina abyssinica</i> Lam. ex DC.	FABACEAE	scrub	x
	<i>Ficus ingens</i> (Miq.) Miq.	MORACEAE	scrub	xx
Chbeha	<i>Ficus sycomorus</i> L.	MORACEAE	scrub	xx
mech	<i>Guizotia scabra</i> (Vis.) Chiov.	ASTERACEAE	Scrub	xx
	<i>Helinus mystacinus</i> (Ait.) E. Mey. ex Steud.	RHAMNACEAE	Scrub	x
dergu	<i>Hypoestes forskoolii</i> (Vahl) R. Br.	ACANTHACEAE	Scrub	xx
	<i>Laggera crispata</i> (Vahl)	ASTERACEAE	Scrub	xx

Local Name	Scientific Name	Family Name	Habitat	Abundance
	Hepper & Wood			
yewof kolo	<i>Lantana camara</i> L.	VERBENACEAE	scrub	xxx
	<i>Launaea intybacea</i> (Jacq.) Beauv.	ASTERACEAE	Scrub	x
Ras kimir	<i>Leucas martinicensis</i>	LAMIACEAE	Scrub	xx
Atate	<i>Maytenus gracilipes</i> (Welw. ex Oliv.) Exell	CELASTERACEAE	scrub	x
	<i>Melinis repens</i> (Willd.) Zizka	POACEAE	Scrub	x
amira	<i>Plumbago zylanica</i> L.	PLUMBAGINACEAE	scrub	xx
beshbisha	<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	FABACEAE	scrub	xxx
	<i>Senna singueana</i> (Del.) Lock.	FABACEAE	Scrub	x
embuway	<i>Solanum incanum</i> L.	SOLANACEAE	scrub	xx
	<i>Sporobolus piliferus</i> (Trin.) Kunth.	POACEAE	Scrub	x
	<i>Tagetes minuta</i> L.	ASTERACEAE	scrub	xxx
	<i>Tagetes patula</i> L.	ASTERACEAE	scrub	X
	<i>Trichodesma zeylanicum</i> (L.) R. Br.	BORAGINACEAE	Scrub	x
	<i>Triumfetta rhombodea</i> Jacq.	TILIACEAE	Scrub	x

**Trees**

	<i>Acacia abyssinica</i>	FABACEAE	forest	x
este patos	<i>Dracaena steudneri</i> Engler	DRACENACEAE	forest	xx
shola	<i>Ficus sp.</i>	MORACEAE	forest	x
	<i>Ficus sycomorus</i>	MORACEAE	forest	x
chbeha	<i>Ficus thonningii</i> Blume.	MORACEAE	forest	xx

## 5.2 LIST OF FLORA IN THE STUDY AREA

This list was compiled during botanical surveys by the ESIA study team (Melaku Wondafrash) in and near the Project Command Area in March 2010.

Some plants are only identified to genus or family level; species identification will follow after comparison with reference herbarium specimens.

Local Name	Species	Description	Abundance
Locality 1: Gorgora Port Hotel		Date 07 Mar 2010	Alt 1888 m
GPS	12° 14.351	037° 18.115	
Papaya	<i>Carica papaya</i> L.	Ornamental	x
	Queen of the night	Ornamental	x
Bahir zaf	<i>Eucalyptus</i>	Planted	x
	<i>Nerium oleander</i> L.		x
Shola	<i>Ficus</i> sp.	Remnant forest tree	x
Este patos	<i>Dracaena steudneri</i> Engler	Remnant forest tree	xx
Chbeha	<i>Ficus thonningii</i> Blume.	Remnant forest tree	xx
		Remnant forest tree	xx
		Remnant forest tree	xx
Locality 2: Gorgora: Pumping Station		Date 07 Mar 2010	Alt 1793 m
GPS	12° 15.686	037° 18.183	
		Rocky outcrop	
	<i>Typha latifolia</i> L.	lake shore	xx
	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	Seasonally flooded areas	xxx
	<i>Cyperus</i>	lake shore	xxx
	<i>Ludwigia stolonifera</i> (Guill. & Perr.) Raven	lake shore & seasonally flooded areas	xxx
Locality 3: Gorgora: Dirma River		Date 07 Mar 2010	Alt 1794 m
GPS	12° 15.932	037° 18.556	
	<i>Sesbania</i>		xxx
	<i>Salix mucronata</i> Thunb.	River bank	xxx
	<i>Ludwigia stolonifera</i> (Guill. & Perr.) Raven	Riverside habitats	xxx
	<i>Vernonia</i> type shrubby herb	River bank	xxx
	<i>Argemone mexicana</i> L.	seasonally flooded areas	xxx
	<i>Crisium</i>	seasonally flooded areas	xxx
	<i>Ageratum conyzoides</i> L.	seasonally flooded areas	xx
	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	Riverside habitats	xxx
	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	seasonally flooded areas	xxx
	<i>Solanecio</i>	River bank	x
Locality 4: Gorgora: rocky hill near Pumping Station, called Kurtiye Hill		Date 07 Mar 2010	Alt 1811 m
GPS	12° 15.787	037° 18.205	
Beshbisha	<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	Rocky hill scrub	xxx
	<i>Lantana camara</i> L.	Rocky hill scrub	xxx
	<i>Tagetes minuta</i> L.	Rocky hill scrub	xxx
	<i>Tagetes patula</i> L.	Rocky hill scrub	X

Local Name	Species	Description	Abundance
	Ficus	Rocky hill scrub	xx
Chbeha	Ficus	Rocky hill scrub	xx
Atate	? Maytenus	Rocky hill scrub	x
	<i>Amaranthus spinosus</i> L.	Rocky hill scrub	xx
	<i>Datura stramonium</i> L.	Rocky hill scrub	xx
	<i>Erythrina abyssinica</i> Lam. ex DC.	Rocky hill scrub	x
	Albizia	Rocky hill scrub	x
	? <i>Azadiricta</i>	Rocky hill scrub	x
	<i>Solanum incanum</i> L.	Rocky hill scrub	xx
	<i>Plumbago zylanica</i> L.	Rocky hill scrub	xx
	Acacia	Rocky hill scrub	x
	Echinops	Rocky hill scrub	xxx
Yemedir embuway	Cucumis	Base of rocky hill	x
	<i>Hypoestes forskoolii</i> (Vahl) R. Br.	Base of rocky hill	xx
	<i>Ageratum conyzoides</i> L.	Base of rocky hill	xxx
	Leucas	Rocky hill scrub	xx
	<i>Crotalaria incana</i> L.	Rocky hill scrub	x
	<i>Cynoglossum</i>	Rocky hill scrub	x
	Laggera	Rocky hill scrub	xx
Locality 5: Lake Tana, Achera Mariam		Date 08 Mar 2010	Alt 1788 m
GPS	12° 16.192	037° 21.877	
Engecha	Cyperus	Lakeshore, seasonally flooded areas	XXX
Afeshfash	Echinocloa	Lakeshore, seasonally flooded areas	XXX
	<i>Nymphoides indica</i> (L.) O. Kuntze	Floating herb on the lake	xx
	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	Lakeshore, seasonally flooded areas	XXX
Locality 6: Lake Tana, Achera, Abalay Toka area		Date 08 Mar 2010	Alt 1787 m
GPS	12° 15.910	037° 22.154	
Gumamla	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	seasonally flooded areas & farmland	XXX
	<i>Ludwigia stolonifera</i> (Guill. & Perr.) Raven	seasonally flooded areas & farmland	XXX
Kurimba	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	seasonally flooded areas & farmland	XXX
Afeshfash	Echinocloa	seasonally flooded areas	xxx
	Cyperus	seasonally flooded areas	
	<i>Phyla nodiflora</i> (L.) Greene	pasture	xx
	<i>Trifolium</i>	pasture	
	<i>Verbena officinalis</i>	pasture	xx
	<i>Alternanthera</i>	pasture	x
	<i>Sida</i> sp.	pasture	x
Locality 7: Lake Tana, Achera, in village area dominated by Eucalyptus plantation & farmland		Date 08 Mar 2010	Alt 1790 m
GPS	12° 16.475	037° 21.354	
Serk abeba	<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	Eucalyptus plantation & farmland	xxx
Dengua / Engecha	Cyperus	Eucalyptus plantation & farmland	xxx
	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	Eucalyptus plantation & farmland	xxx

Local Name	Species	Description	Abundance
Gumamla	Persicaria senegalensis (Meisn.) Miyabe	Eucalyptus plantation & farmland	xxx
Seya	? Hibiscus	Eucalyptus plantation & farmland	x
Amerarit	Spheanthus	Eucalyptus plantation & farmland	xx
Hira hira		Eucalyptus plantation & farmland	x
Gorgegit	Sida	Eucalyptus plantation & farmland	x
Yaheya eshoh		pasture	xxx
Awunda	Gutenergia	pasture	x
Asendabo	Grass	pasture	xx
Maget	Trifolium	pasture	x
	Evolvulus alsinoides (L.) L.	pasture	x
	Verbena officinalis	pasture	x
	Amaranthus spinosus L.	pasture	x
	Cynodon	pasture	xxx
	Datura stramonium L.	pasture	xx
Derge eshoh	Xanthium strumarium L.	pasture	xx
Nech eshoh	Argemone mexicana L.	pasture	xxx
Locality 8: Lake Tana, Achera, Ashewa Bahir		Date 08 Mar 2010	Alt 1789 m
GPS	12° 16.557	037° 21.240	
	Dicliptera	Grazing land	x
	Ipomea	Grazing land	x
	Indogofera	Grazing land	x
	Acacia	Grazing land	x
Locality 9: Lake Tana, Dablo Mariam		Date 08 Mar 2010	Alt 1798 m
GPS	12° 16.	037° 21.	
		Grazing land in Dablo Mariam	
	Persicaria senegalensis (Meisn.) Miyabe	seasonally flooded areas & farmland	XXX
	Ludwigia stolonifera (Guill. & Perr.) Raven	seasonally flooded areas & farmland	XXX
	Hygrophila schulli (Hamilt.) M. R. & S. M. Almeida.	seasonally flooded areas & farmland	XXX
Locality 10: Lake Tana, Achera near farm in association with Eucalyptus plantation		Date 08 Mar 2010	Alt 1791 m
GPS	12° 16.778	037° 21.385	
Guwaro tebaqi	Datura stramonium L.	farm	xx
Qachima	Ricinus communis L.	farm	xx
	Eucalyptus	farm	xxx
	Senna didymobotrya (Fresen.) Irwin & Barneby	farm	xxx
	Hygrophila schulli (Hamilt.) M. R. & S. M. Almeida.	farm	xxx
	Plantago lanceolata L.	farm	xx
	Crisim	farm	xxx
	Cynodon	farm	xxx
	Crotalaria spinosa Hochst ex Benth.	farm	x
	Solanum incanum L.	farm	x
	Ageratum conyzoides L.	farm	xx

Local Name	Species	Description	Abundance
	Cynoglossum	farm	x
	Cardiospermum halicacabum L.	farm	x
	Centella asiatica (L.) Urban	farm	xx
	Asteraceae - weed	farm	xx
Locality 11: 9 km from Gorgora on the way to Gonder on the edge of the project: stream margin vegetation		Date 09 Mar 2010	Alt 1790 m
GPS	12° 16.475	037° 21.354	
		The stream was covered with algae	
	Gophornia	stream margin vegetation	x
	Cardus	stream margin vegetation	xx
	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	stream margin vegetation	xxx
	Laggera	stream margin vegetation	x
	Maytenus	stream margin vegetation	x
	<i>Persicaria senegalensis</i> (Meisn.) Miyabe	stream margin vegetation	xxx
	Senna	stream margin vegetation	x
	<i>Xanthium strumarium</i> L.	stream margin vegetation	xx
	<i>Plantago lanceolata</i> L.	stream margin vegetation	x
	Acacia	stream margin vegetation	x
	<i>Fabaceae</i> - yellow flower	stream margin vegetation	x
Locality 12: 15-20 km from Gorgora towards Gonder on the edge of the project, along Dana river		Date 09 Mar 2010	Alt 1860 m
GPS	12° 17.078	037° 13.757	
	Cyperus	stream margin	xx
	Cyperus	stream margin	xx
	<i>Veronica anagallis-aquatica</i>	stream margin	xx
Locality 13: Junction of cooperative road from Kola Diba, 13 - 16 km on the way to Guramba Bata at a place called Salga Kidane Mehrete		Date 09 Mar 2010	Alt 1830 m
GPS	12° 24.747	037° 20.009	
	Acacia	Farmland with scattered Acacia shrub & trees	x
	Maytenus	Farmland with scattered Acacia shrub & trees	x
	Asteraceae - Weed	Farmland with scattered Acacia shrub & trees	x
	Senna	Farmland with scattered Acacia shrub & trees	x
	Pimpinella	Farmland with scattered Acacia shrub & trees	x
Locality 14: Upper part of Megech River		Date 09 Mar 2010	Alt 1870 m
GPS	12° 29.233	037° 26.848	
	Echinops	Riverside	xxx
	<i>Argemone mexicana</i> L.	Riverside	xxx
	<i>Hygrophila schulli</i> (Hamilt.) M. R. & S. M. Almeida.	Riverside	xxx
	<i>Amaranthus spinosus</i> L.	Riverside	x
	Laggera	Riverside	x
	<i>Tagetes minuta</i> L.	Riverside	xx
	<i>Centella asiatica</i> (L.) Urban	Riverside	x
Agam	<i>Carissa spinarum</i>	Riverside	xxx

Local Name	Species	Description	Abundance
Bamba	Ficus	Riverside	
Shete	<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	Riverside	xxx
	<i>Conyza stricta</i> Willd.	Riverside	x
	<i>Ageratum conyzoides</i> L.	Riverside	x
	<i>Gomphocarpus</i>	Riverside	x
	<i>Ipomea</i>	Riverside	x
Beshbesha	<i>Senna</i>	Riverside	x
	<i>Stephania abyssinica</i> (Dillon et A. Rich.) Walp.	Riverside	x
	<i>Maytenus</i>	Riverside	x
	<i>Vernonia</i>	Riverside	x
Chebeha	Ficus	Riverside	x

### 5.3 LISTS OF BIRDS IN THE STUDY AREA

Annex 5.3.1 Key Birds of Amhara Region	
Category 1 Globally Threatened species	
Vulnerable	Near Threatened
Harwood's Francolin	Lesser Flamingo
Wattled Crane	Black Crowned Crane
Greater Spotted Eagle	Pallid Harrier
Lesser Kestrel	Black-tailed Godwit
Ankober Serin	Great Snipe
	Rouget's Rail
	Abyssinian Longclaw
	Basra Reed Warbler
Category 2 Restricted-range species	
Rüppell's Chat	
Sombre Chat	
Ankober Serin	
Endemic to Ethiopia	Restricted to highland biome
Harwood's Francolin	Wattled Ibis
Spot-breasted Plover	Blue-winged Goose
Yellow-fronted Parrot	Rouget's Rail
Abyssinian Woodpecker	White-collared Pigeon
Abyssinian Longclaw	Black-winged Lovebird
Abyssinian Catbird	Banded Barbet
Black-headed Siskin	Rüppell's Chat
Ankober Serin	White-winged Cliff Chat
	White-backed Black Tit
	White-billed Starling
	Abyssinian Black-headed Oriole (Dark-headed Oriole)
	Thick-billed Raven
	White-cheeked Turaco



## Annex 5.3.2 Birds recorded in Study Area

No.	Order & Family	Genus and Species	Common Name	Observed at Dirma River		Observed in area ESIA field surveys 2009	Numbers recorded during 2007 IBA bird count			Status
				Nega Tassie 2006-2007	Crane count 2008-2009		Site 14 Gorgora Seraba shoreline	Site 18 Dirma River (north)	Site 19 Dirma River (south)	
1	Accipitriformes: Accipitridae	Lophaetus occipitalis	Long-crested Eagle		X					
2	Anseriformes: Anatidae	Alopochen aegyptiacus	Egyptian Goose	X	X	X	22	49		
3	Anseriformes: Anatidae	Anas crecca	Common Teal	X				182		
4	Anseriformes: Anatidae	Anas acuta	Northern Pintail						1	
5	Anseriformes: Anatidae	Anas clypeata	Northern Shoveller	X				35		
6	Anseriformes: Anatidae	Anas querquedula	Garganey	X			8			
7	Anseriformes: Anatidae	Anas sp.	Ducks anas sp.				80			
8	Anseriformes: Anatidae	Anas undulata	Yellow-billed Duck	X		X	2			
9	Anseriformes: Anatidae	Dendrocygna viduata	White Faced Whistling Duck	X						
10	Anseriformes: Anatidae	Plectropterus gambensis	Spur-winged Goose	X	X	X	168	90		
11	Anseriformes: Anatidae	Sarkidiornis melanotos	Knob-billed Duck			X			8	
12	Charadriiformes: Burhinidae	Burhinus senegalensis	Senegal Thick-knee				1			
13	Charadriiformes: Charadriidae	Charadrius pecuarius	Kittlitz's Plover					1		
14	Charadriiformes: Charadriidae	Vanellus lugubris	Senegal Wattled Plover / Lapwing	X				3		
15	Charadriiformes: Charadriidae	Vanellus senegallus	African Wattled Lapwing	X						

No.	Order & Family	Genus and Species	Common Name	Observed at Dirma River		Observed in area ESIA field surveys 2009	Numbers recorded during 2007 IBA bird count			Status
				Nega Tassie 2006-2007	Crane count 2008-2009		Site 14 Gorgora Seraba shoreline	Site 18 Dirma River (north)	Site 19 Dirma River (south)	
16	Charadriiformes: Charadriidae	Vanellus spinosus	Spur-winged Plover / Lapwing	X	X		3	25		
17	Charadriiformes: Charadriidae	Vanellus tectus	Black-headed Plover/ Lapwing				1			
18	Charadriiformes: Glareolidae	Glareola pratincola	Common Pratincole					145		
19	Charadriiformes: Jacanidae	Actophilornis africana	African Jacana	X			1			
20	Charadriiformes: Laridae	Larus ichthyaetus	Great Black-headed Gull				1			
21	Charadriiformes: Laridae	Larus fuscus	Lesser Black-backed Gull				9		1	
22	Charadriiformes: Laridae	Larus ridibundus	Black-headed Gull				12			
23	Charadriiformes: Recurvirostidae	Himantopus himantopus	Black-winged Stilt	X		X		2		
24	Charadriiformes: Recurvirostidae	Recurvirostra avosetta	Avocet					5		
25	Charadriiformes: Scolopacidae	Actitis hypoleucos	Common Sandpiper	X			2			
26	Charadriiformes: Scolopacidae	Calidris minuta	Little Stint				2	9	2	
27	Charadriiformes: Scolopacidae	Calidris sp.	Waders				50	55		
28	Charadriiformes: Scolopacidae	Calidris temminckii	Temminck's Stint				1			
29	Charadriiformes: Scolopaciidae	Gallinago gallinago	Common Snipe					2		
30	Charadriiformes: Scolopacidae	Limosa limosa	Black-tailed Godwit		X		1			NT

No.	Order & Family	Genus and Species	Common Name	Observed at Dirma River		Observed in area ESIA field surveys 2009	Numbers recorded during 2007 IBA bird count			Status
				Nega Tassie 2006-2007	Crane count 2008-2009		Site 14 Gorgora Seraba shoreline	Site 18 Dirma River (north)	Site 19 Dirma River (south)	
31	Charadriiformes: Scolopacidae	Philomachus pugnax	Ruff				133	149		
32	Charadriiformes: Scolopacidae	Tringa erythropus	Spotted Redshank					2		
33	Charadriiformes: Scolopacidae	Tringa glareola	Wood Sandpiper				1	4		
34	Charadriiformes: Scolopacidae	Tringa nebularia	Greenshank	X				6		
35	Charadriiformes: Scolopacidae	Tringa ochropus	Green Sandpiper				1	2		
36	Charadriiformes: Scolopacidae	Tringa stagnatilis	Marsh Sandpiper					6		
37	Charadriiformes: Sternidae	Chlidornias leucopterus	White-winged Black Tern				1762			
38	Ciconiiformes: Ardeidae	Ardea alba	Great White Egret		X	X	10	3		
39	Ciconiiformes: Ardeidae	Ardea cinerea	Grey Heron	X	X		15	2		
40	Ciconiiformes: Ardeidae	Ardea goliath	Goliath Heron	X		X	3			
41	Ciconiiformes: Ardeidae	Ardea melanocephala	Black-headed Heron	X		X		4		
42	Ciconiiformes: Ardeidae	Ardea purpurea	Purple Heron	X			1			
43	Ciconiiformes: Ardeidae	Ardeola ralloides	Squacco Heron	X	X		5			
44	Ciconiiformes: Ardeidae	Bubulcus ibis	Cattle Egret	X	X	X	130	270		
45	Ciconiiformes: Ardeidae	Egretta garzetta	Little Egret			X				
46	Ciconiiformes: Ardeidae	Egretta intermedia	Yellow-billed Egret				3	3		
47	Ciconiiformes: Ardeidae	Egretta sp.	Egret sp.				111			
48	Ciconiiformes: Ciconiidae	Anastomus lamelligerus	Open-billed Stork		X					
49	Ciconiiformes: Ciconiidae	Ciconia abdimii	Abdim's Stork			X				

No.	Order & Family	Genus and Species	Common Name	Observed at Dirma River		Observed in area ESIA field surveys 2009	Numbers recorded during 2007 IBA bird count			Status
				Nega Tassie 2006-2007	Crane count 2008-2009		Site 14 Gorgora Seraba shoreline	Site 18 Dirma River (north)	Site 19 Dirma River (south)	
50	Ciconiiformes: Ciconiidae	Ciconia episcopus	Woolly-necked Stork		X		7			
51	Ciconiiformes: Ciconiidae	Mycteria ibis	Yellow-billed Stork	X	X	X				
52	Ciconiiformes: Threskiornithidae	Bostrychia hagedash	Hadada Ibis	X		X	2	1		
53	Ciconiiformes: Threskiornithidae	Threskiornis aethiopicus	Sacred Ibis	X	X	X	31	6		
54	Ciconiiformes: Threskiornithidae	Platalea alba	African Spoonbill	X		X		11		
55	Ciconiiformes: Threskiornithidae	Plegadis falcinellus	Glossy Ibis			X	10	7		
56	Columbiformes: Columbidae	Columba guinea	Speckled Pigeon	X						
57	Columbiformes: Columbidae	Streptopelia capicola	Ring Necked Dove	X						
58	Columbiformes: Columbidae	Streptopelia semitorquata	Red-eyed Dove	X						
59	Coraciiformes: Alcedinidae	Ispidina picta	African pygmy-Kingfisher						2	
60	Coraciiformes: Cerylidae	Ceryle rudis	Pied Kingfisher		X					
61	Coraciiformes: Meropidae	Merops nubicus	Carmine Bee-eater	X		X				
62	Coraciiformes: Meropidae	Merops variegatus	Blue-breasted Bee-eater	X						
63	Falconiformes: Accipitridae	Circus aeruginosus	European Marsh Harrier				5	2		
64	Falconiformes: Accipitridae	Circus macrourus	Pallid Harrier					2		NT
65	Falconiformes: Accipitridae	Circus pygargus	Montagu's Harrier					3		
66	Falconiformes: Accipitridae	Haliaeetus vocifer	African Fish-Eagle				2	1		

No.	Order & Family	Genus and Species	Common Name	Observed at Dirma River		Observed in area ESIA field surveys 2009	Numbers recorded during 2007 IBA bird count			Status
				Nega Tassie 2006-2007	Crane count 2008-2009		Site 14 Gorgora Seraba shoreline	Site 18 Dirma River (north)	Site 19 Dirma River (south)	
67	Falconiformes: Pandionidae	Pandion haliaetus	Osprey				1			
68	Galliformes: Phasianidae	Francolinus sephaena	Crested Francolin	X						
69	Gruiformes: Gruidae	Balearica pavonina	Black-Crowned Crane	X	X	X	173	38		NT
70	Gruiformes: Gruidae	Grus grus	Common or Eurasian Crane	X	X		8			
71	Gruiformes: Rallidae	Gallinula chloropus	Common Moorhen				3			
72	Passeriformes: Alaudidae	Eremopterix leucotis	Chestnut-backed Sparrow-Lark						5	
73	Passeriformes: Corvidae	Corvus albus	Pied Crow	X		X				
74	Passeriformes: Corvidae	Corvus capensis	African Rook	X						
75	Passeriformes: Corvidae	Corvus rhipidurus	Fan-tailed Raven	X						
76	Passeriformes: Corvidae	Corvus sp.	Crow			X				
77	Passeriformes: Estrildidae	Lagonosticta senegala	Red-billed Firefinch						1	
78	Passeriformes: Fringilidae	Serinus leucopygia	White Rumped Serin	X						
79	Passeriformes: Motacillidae	Motacilla flava	Yellow Wagtail		X					
80	Passeriformes: Passeridae	Passer griseus	Grey-headed Sparrow	X						
81	Passeriformes: Ploceidae	Euplectes afer	Yellow Crowned Bishop	X						
82	Passeriformes: Ploceidae	Ploceus luteus	Little Weaver	X						
83	Passeriformes: Ploceidae	Ploceus melanocephalus	Black-headed Weaver	X						
84	Passeriformes: Sturnidae	Buphagus erythrorhynchus	Red-billed Oxpecker						22	

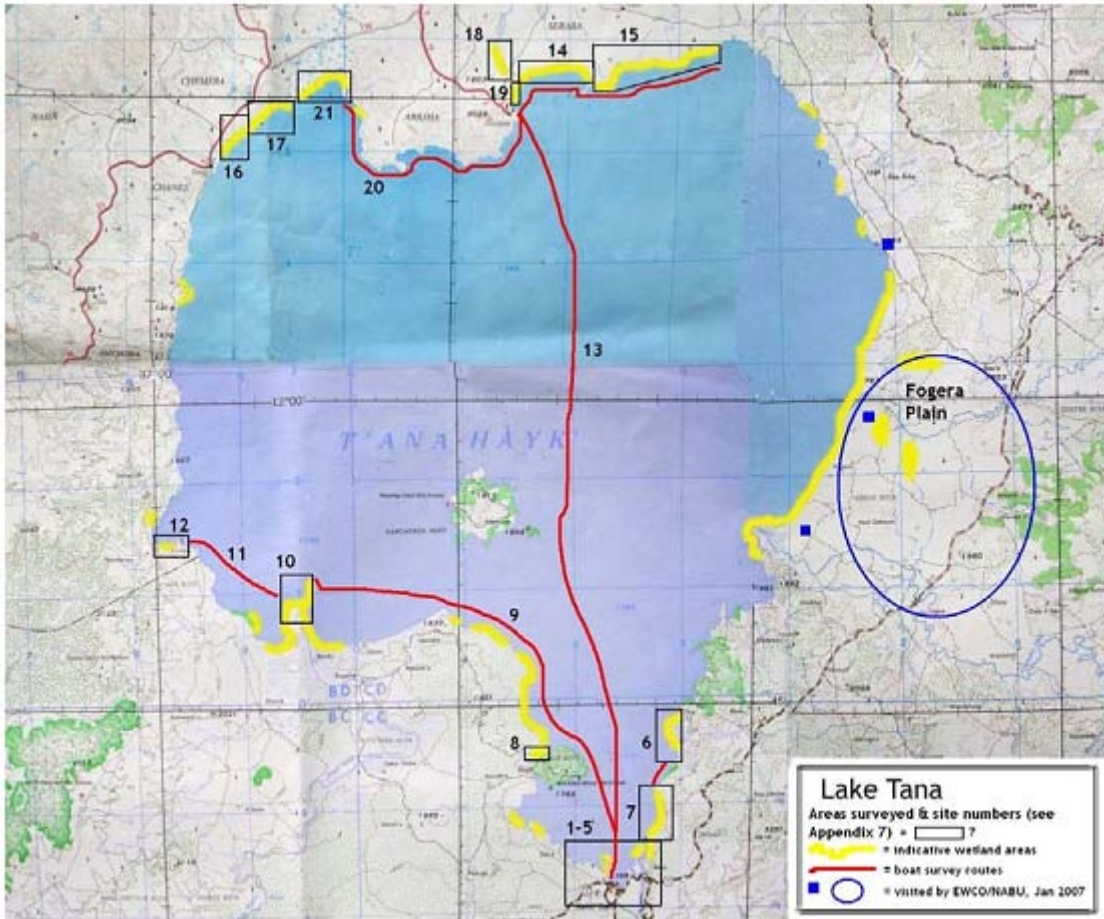
No.	Order & Family	Genus and Species	Common Name	Observed at Dirma River		Observed in area ESIA field surveys 2009	Numbers recorded during 2007 IBA bird count			Status
				Nega Tassie 2006-2007	Crane count 2008-2009		Site 14 Gorgora Seraba shoreline	Site 18 Dirma River (north)	Site 19 Dirma River (south)	
85	Passeriformes: Sturnidae	Lamprotornis chalbeus	Greater eared Blue-glossy Starling	X						
86	Pelicaniformes: Anhingidae	Anhinga melanogaster	African Darter				12			
87	Pelicaniformes: Pelicanidae	Pelicanus onocrotalus	Great White Pelican	X			3	4		
88	Pelicaniformes: Phalacrocoracidae	Phalacrocorax africanus	Reed or Long-tailed Cormorant		X		24			
89	Pelicaniformes: Phalacrocoracidae	Phalacrocorax carbo	Great or Black Cormorant				7			
90	Podicipediformes: Podicipedidae	Tachybaptus ruficollis	Little Grebe		X					
	Number of species			42	19	20	43	34	8	
	Number of individuals						2827	1129	42	

- E Endemic  
 VU Category 1 Globally threatened species - Vulnerable  
 NT Category 1 Globally threatened species - Near Threatened  
 RHB Restricted to highland biome

Sources:  
 Francis, I.S. & Shimelis Aynalem. 2007. Bird Surveys around Bahir Dar - Lake Tana IBA, Ethiopia. RSPB/AAU.  
 Nega Tassie. 2007. Diversity, Distribution, Abundance and Habitat Association of Birds of Dembia Plain Wetlands, Lake Tana, Ethiopia. MSc thesis, Dept. of Biology, AAU.  
 Shimelis Aynalem. 2009. Biology and Ecology of Cranes at Lake Tana. Project Report, 2008/2009. Conservation, Education and Eco-tourism Project at Lake Tana. EWNHS / NABU-Crane Conservation Germany.

## 5.4 EXTRACTS FROM 2007 IBA BIRD COUNT

### Annex 5.4.1: Map showing 2007 IBA Bird Count Sites



Source: Francis & Shimelis Aynalem (2007).

**Annex 5.4.2 Site 14: Gorgora/Seraba**

**LAKE TANA WETLAND BIRD SURVEY**  
**January-February 2007**  
**Sub-site data sheet**

Site no. and name:  
**14. Gorgora/Seraba**  
 (Gorgora Port to first major promontory eastwards)

GPS location (range):  
 12° 14' 25"N, 37° 18' 06"E to  
 12° 15' 22.5"N, 37° 21' 32.0"E

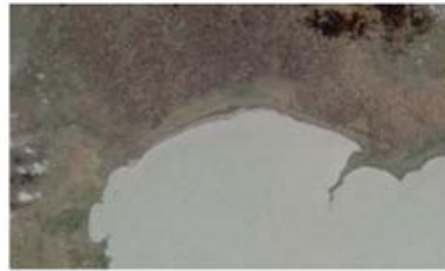
Dates visited: 22 January 2007      Observers: IF, SA



Site location and approximate area surveyed



**General description and site conditions:**  
 A length of shoreline of c.5 km, extending c.1000 m from the shore. Much of its length consists of sedge-dominated vegetation of varying width, backed by cropped and grazed areas, with burning in places; in some areas, agricultural land extends to the water's edge. No Papyrus was seen. The promontory at the eastern end of the section has a line of Eucalyptus trees and scattered settlement. The extent of wetland varies significantly through the season: the following satellite images show how water levels change from the end of the dry season in June to the wet season in November.



Variation of extent of wet areas, June 2006 (above) and November 2006 (below). Digital Globe images.



**Method of count and coverage of area:**  
 All census work was undertaken by boat. Most important wetland areas were viewed, though with varying degrees of efficiency for different species. In the west, care was taken to avoid double counting of birds using sub-section 19. At the eastern end, only birds on the west side of the promontory were counted.

**Bird highlights and overall total:**  
 EWNHS counted this wetland in December 1993 (EWNHS 1996), but we have not obtained these counts. It forms part of an M.Sc study by Nega Tassie in November 2006 and Feb/March 2007. Belay Abdissa noted 1,000 - 5,000 wetland birds here on 16 dates in 2003 and 2004. In our census, 2,829 birds of 43 wetland species were recorded. Notable counts were 254 egrets (mostly Cattle but also 10 Great White), 3 Goliath Herons, 7 Woolly-necked Storks, 168 Spur-winged Geese, 173 Crowned Cranes, 133 Ruff and the large total of 1,762 White-winged Black Terns.



African Long-tailed (Reed) Cormorant



**14. Gorgora/Seraba (continued)**

**Human activity, threats and conservation issues:**

The hinterland is cropped and grazed, and in some cases this extends to the water's edge. There is settlement and much fishing activity in the area. Wetlands here would be vulnerable to any reduced incidence of flooding through stabilised (or lower) lake water levels.



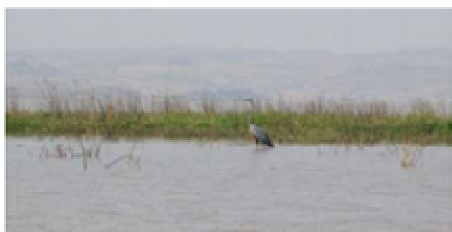
*Wetland edge near eastern promontory*

*There was much fishing activity in the area*



**Recommendations:**

This area forms the southern lake edge of a large agricultural plain that floods in the wet season and which includes or adjoins Sites 15, 18 and 19. The whole area is important for birds and should be surveyed in more detail.



*Goliath Heron in context*



*Squacco herons are easily underestimated as they often hide in long vegetation*



*This site was good for Black-crowned Cranes*



*Large numbers of White-winged Black terns were seen here*



*View of site from west*

**Annex 5.4.3 Site 18: Gorgora/Dirma River (north)**

**LAKE TANA WETLAND BIRD SURVEY**  
 January-February 2007  
 Sub-site data sheet

Site no. and name:  
**18. Gorgora/Dirma River (north)**

GPS location (centre):  
 Just east of 12° 16' 31.5"N, 37° 16' 31.9"E

Dates visited: 24 January 2007  
 Observers: IF, SA



Site location and approximate area surveyed



**General description and site conditions:**  
 A large floodplain area around the Dirma river. Much of the land is, or has been, cultivated, with some areas close to the river dominated more by marsh and seasonally inundated grassland. The wet area was receding as the water level drops, but still covered a large area of land and held a very significant number of birds.

**Method of count and coverage of area:**  
 The census was undertaken on foot, with an overview count from the large conical hill just west of the site, followed by a walk along the western edge. Most of the important wetland area was viewed, though with varying degrees of efficiency for different species. In particular, small *Calidris* waders and *Anas* ducks in the centre of the site were not well counted.

**Bird highlights and overall total:**  
 As far as we know, this wetland area has not been counted formally before, though it does overlap with an area being studied by Nega Tassie for his M.Sc thesis, and may have been counted by EWNHS in 1993 (EWNHS 1996). A total of 1,127 birds of 34 wetland species was recorded. Notable counts were 270 Cattle Egrets, 11 African Spoonbills, 90 Spur-winged Geese, 182 Common Teal and 35 Shovelers, two Pallid Harriers, 145 Common Pratincoles and wide range of *Calidris* waders plus 149 Ruff. This total is likely to be a significant underestimate, and the whole area, especially when combined with Sites 14 and 18, is important for wetland birds.



View of central flooded area

**Human activity, threats and conservation issues:**  
 The fringes of the site are cultivated with chick peas, and nearer the edges, maize and sorghum. Cattle graze over much of the area too, and active ploughing of the receding water's edge was underway during the visit. There are many people in the area. At the south of the site, towards Gorgora, the floodplain becomes more intensively farmed, with an irrigation system and cultivation of maize, along with some fringing planting of *Eucalyptus* trees. This site is very

**18. Gorgora/Dirma River N (continued)**

vulnerable to further agricultural conversion, and to any restriction of the seasonal inundation or a lowering of lake water levels.



*Ploughing taking place behind a group of Black-crowned Cranes*



*Inundated area in the centre of the site*



*Ploughing takes place as soon as water levels fall, before the soil becomes too hard - the 'Bahir Shesh' cultivation method.*



*Irrigation is found towards the south of the site, with maize cultivation*



*Spur-winged Geese, Grey Heron, Eurasian Teal and Showeters in central wet area*



*Common Pratincoles were hawking insects over the wetland*

**Recommendations:**

This area forms the northern part of a large agricultural plain that floods in the wet season and which includes or adjoins Sites 14 and 19. The whole area is important for birds and should be surveyed in more detail.

**Annex 5.4.4 Site 19: Dirma River/Gorgora (west)**

**LAKE TANA WETLAND BIRD SURVEY**  
**January-February 2007**  
**Sub-site data sheet**

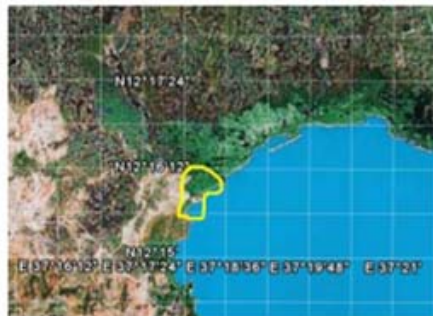
Site no. and name:  
**19. Dirma River/Gorgora (west)**

GPS location (*centre*):  
 12° 15' 52.3"N, 37° 18' 08.4"E

Dates visited:                      Observers:  
 24 January 2007                      IF, SA



Site location and approximate area surveyed



**General description and site conditions:**  
 South of the Dirma River (North) site [17] and the extreme western end of the Gorgora/Seraba site [14], but lying inland and not well counted on the boat census of that site, so counted separately.

**Method of count and coverage of area:**  
 The census was undertaken on foot, with an overview count from the hill to the north of the site, followed by a walk into the middle. All of the important wetland area was viewed, and generally quite efficiently.

**Bird highlights and overall total:**  
 This wetland area overlaps with areas being studied by Nega Tassie for his M.Sc thesis, and Belay Abdissa recorded an average of 353 wetland birds in this area on 16 dates in 2003 and 2004. It was probably counted by EWNHS in 1993 (EWNHS 1996). We counted 42 birds of 8 wetland species on this small marsh. Notable counts were 22 Glossy Ibis and 8 Pintail. Likely double-counted birds were excluded from the totals.



General overview of area across to Site 14



Detailed view of part of the site



Senegal Wattled Plover - present in the area but counted within Site 14

**Human activity, threats and conservation issues:**  
 Cattle grazed, not cultivated. The site is vulnerable to any restriction of the seasonal inundation or a lowering of lake water levels.

**Recommendations:**  
 Part of an area important for birds and should be surveyed in more detail with Sites 14 and 18.

## 5.5 LIST OF MAMMALS IN THE STUDY AREA

### Animals recorded during 2005-2006 Bird Surveys of Dembia Plain by Nega Tassie (2007)

Common Name	Scientific Name	Local Name	Comment
African Civet	<i>Civettictis civetta</i>	Tirign	
Bushbuck	<i>Tragelaphus scriptus</i>	Dikula	
Crested Porcupine	<i>Hystrix cristata</i>	Jart	
Duiker	<i>Sylvicapra grimmia</i>	Midakua	
Genet	<i>Genetta sp.</i>	Shelemetmat	
Hippopotamus	<i>Hippopotamus amphibius</i>	Gumarie	
Jackal	<i>Canis mesomelas</i>	Kebero	
Nile Monitor	<i>Varanus niloticus</i>	Arjano	
Olive Baboon	<i>Papio anubis</i>	Tera zinjero	
Serval	<i>Felis serval</i>	Aner	
Spotted Hyaena	<i>Crocuta crocuta</i>	Tera jib	
Vervet Monkey	<i>Cercopithecus aethiops</i>	Tera tota	

### Additional Animals observed by or reported to ESIA Study Team (2008-2010)

Common Name	Scientific Name	Local Name	Comment
Aardvark	<i>Orycteropus afer</i>		
Aardwolf	<i>Proteles cristatus</i>		
African Rock Python	<i>Python sebae</i>		
Clawless Otter	<i>Aonyx capensis</i>		Uncertain
Colobus Monkey	<i>Colobus guereza</i>		

## 6. Annex 6 - Fisheries Data and Information

### 6.1 LIST OF SMALL TRIBUTARIES OF DIRMA RIVER

Small Tributaries of Dirma River which Cross the Gorgora-Kola Diba Road and are assumed to be used for Spawning or access to Spawning Sites

Name of the tributary	Location	Coordinates of crossing
Dabit	4 km from Gorgora town	12° 15'188" and 37° 16'695
Abakura	8 km from Gorgora town	12° 15'779" and 37° 15'085"
Shiwenz	9 km from Gorgora town	12° 16'883" and 37° 13'860"
Gerarge	13 km from Gorgora town	12° 17'751" and 37° 13'563"
Melakem wuha	23 km from Gorgora town	12° 21'893" and 37° 15'474"
Chechela	26 km from Gorgora town	12° 22'528" and 37° 16'746"
Tantikura	29 km from Gorgora town	12° 23'783" and 37° 17'832"
Sudi Gedel	30 km from Gorgora town	12° 24'101" and 37° 18'111"
Gabikuna	33 km from Gorgora town	12° 25'244" and 37° 19'250"
Kench wuha	33 km from Gorgora town	12° 25'244" and 37° 19'250"

Note: additional, smaller tributaries on the right bank of the Dirma River exist and are used for fishing, e.g. Dhana, Hahacha and Gilgel, but these do not cross the main road

Source: Consultant's field surveys

### 6.2 LOCATION OF DRY SEASON FISH SAMPLING SITES, 2009

In Jan-Feb 2009 fish were caught using gill nets of various mesh sizes (6, 8, 10 and 12 cm) at 6 locations in and near the Project Command Area. Beach seines and cast nets were also employed.

No.	Location	GPS	
		N	E
1	Lake Tana around the pumping site	12° 15'619"	37° 18'279"
2	Lake Tana at Dirma River mouth	12° 15'749"	37° 18'672"
3	Nedit River	12° 17'080"	37° 20'120"
4	Dirma River lower reaches ("Doro Mender")	12° 17'103"	37° 17'339"
5	Dirma River lower reaches ("Wawa" Farm)	12° 16'744"	37° 17'527"
6	Dirma River upper reaches ("Kola Diba")	12° 26'211"	37° 20'158"

Source: Consultant's field survey

## 6.3 RAW DATA ON FISH SPECIES CAUGHT DURING FIELD SURVEY (JANUARY-FEBRUARY 2009)

Annex 6.3.1: Raw Data on Maturity of Fish Species sampled during Field Survey (Jan - Feb 2009)

Sampling Site	Species	Maturity Stage							Unidentified (juveniles)
		I	II	III	IV	V	VI	VII	
Lake Tana: site of future pumping station	L. brevicephalus		6	1					
	L. crassibarbis		1						
	L. intermedius		6						
	L. megastoma			1					
	L. platydorsus			1					
	L. surkis		1						
	L. truttiformis		1						
	L. tsanensis		9	2					
	V. beso		1						
	C. gariepinus		1						
	O. niloticus		1	1	1	1			
Lake Tana: at mouth of Dirma River	L. acutirostris	1	2						
	L. intermedius		4	2	1				
	L. gorgorensis		2						
	L. megastoma		3						
	L. tsanensis		3		3	1			
	O. niloticus				1				
Nededit River	B. humilis								47
	B. tanapelagius								9
	C. gariepinus	7							
	Garra sp.								23
	O. niloticus								2
Dirma River: lower reaches ("Doro Mender")	B. humilis								25
	C. gariepinus	1							
	O. niloticus								47
Dirma River: lower reaches ("Wawa" Farm)	L. brevicephalus		1	1					
	L. intermedius					1			
	L. tsanensis		2						
	B. humilis								83
	C. gariepinus		1	1					1
	Garra sp.								3
Dirma River: upper reaches ("Koladiba")	O. niloticus								88
	L. intermedius	1		1					
	B. humilis								38
	C. gariepinus	1	2						1
	Garra sp.								84
	O. niloticus		4	4					
Total	V. beso				3	1			
		541	11	51	15	9	4		451

Source: Consultant's field surveys

## Annex 6.3.2: ESIA Fish Sampling Data, Jan-Feb 2009

Species	Lake Tana around pumping station	Lake Tana at Dirma river mouth	Nededit River	Dirma river lower reaches (Doro Mender)	Dirma river lower reaches (Wawa farm)	Dirma river upper reaches (Koladiba)	
<i>Labeobarbus acutirostris</i>		3					3
<i>L. brevicephalus</i>	7				2		9
<i>L. crassibarbis</i>	1						1
<i>L. gorgorensis</i>		2					2
<i>L. intermedius</i>	6	7			1	2	16
<i>L. megastoma</i>	1	3					4
<i>L. platydorsus</i>	1						1
<i>L. surkis</i>	1						1
<i>L. truttiformis</i>	1						1
<i>L. tsanensis</i>	11	7			2		20
<i>Barbus humilis</i>			47	25	83	38	193
<i>B. tanapelagius</i>			9				9
<i>Garra sp.</i>			23		3	84	110
<i>Varicorhinus beso</i>	1					4	5
<i>Carias gariepinus</i>	1		7	1	3	4	16
<i>Oreochromis niloticus</i>	4	1	2	47	88	8	150
<b>Total</b>	<b>35</b>	<b>23</b>	<b>88</b>	<b>73</b>	<b>182</b>	<b>140</b>	<b>541</b>
<i>nb of species</i>	11	6	5	3	7	6	
	<b>11%</b>		<b>89%</b>				



## 6.4 LABEOBARBUS SPECIES COMPOSITION IN RIVER MOUTHS AND UPSTREAM TRIBUTARIES

The following table is taken from Wassie Anteneh's MSc 2005 thesis on the Spawning Migration and Reproductive Biology of Labeobarbus (*Cyprinidae: Teleostei*) of Lake Tana to Dirma and Megech Rivers.

Source	River Mouths			Upstream Rivers			
	This study	De Graaf (2003)	Nagelkerke and Sibbing (1996)	This study	Palstra et al., 2004	Dgebuadze et al. (1999)	Nagelkerke and Sibbing (1996)
Sampling period	Dec 2003 –Nov 2004	Jul-Oct 1999 Jul-Oct 2000	Sep-Oct 1993 Sep-Oct 1994	Aug-Oct	Sep-Oct 1999	Sep-Nov 1994 Aug-Oct 2000	Sep 1994
Sampling frequency	Monthly (Nov-Jun), bimonthly (Jul), weekly (Aug-Oct)	Twice per month	3 times Sep 4 times Oct	weekly	Twice per week	Few times	Once
Sampling area	Dirma and Megech	Gumara, Gelda, Rib, and Gelgel Abbay	Gumara	1 tributary and 2 sites in Megech main channel & 1 main channel in Dirma	3 tributaries and 4 locations in main channel of Gumara	1 tributary and 1 location in main channel of Gumara	1 location in main channel of Gumara
Sample size	4280	8147	1530	703	4897	540	70
Species composition	%	%	%	%	%	%	%
L. tsanensis	11.4	15.6	18	16.1	52	33 (a)	42
L. brevicephalus	19.9	14.5	46	20.3	29	36 (b)	27
L. truttiformis	8.2	2.5	1	18.6	5.6	0.5	19
L. megastoma	3.7	2.4	3	2.0	5.0	2	8
L. macrophthalmus	0.4	4.7	23	0.01	4.9	19	0
L. acutirostris	1.1	7.7	5.5	0	3.0	8	0
L. platydorsus	0.7	4.0	1	0	0.7	2	2
L. gorgorensis	0.5	0.7	0.5	0	0.2	0.2	2
L. crassibarbis	1.1	0.4	0.5	0.4	0.1	0.3	0
L. dainellii	0.05	0.1	0	0	0	0	0
L. gorguari	0	0.9	0.3	0	0	0	0
L. surkis	4.0	0.5	0.5	0.7	0	0	0
L. nedgia	0.3	0.9	0.5	3.7	0	0	0
L. longissimus	0.6	0.5	0	0.6	0	0	0
L. intermedius	42.8	44.7	0	37.4	0	0	0

a) Referred to as morphotype "normal intermedius" in Dgebuadze et al. (1996) but named as *L. tsanensis* according to Nagelkerke and Sibbing (2000).

b) Referred to as "precocious intermedius" in Dgebuadze et al. (1996) but named as *L. brevicephalus* according to Nagelkerke and Sibbing (2000).

## 6.5 USE OF THE CANALS FOR AQUACULTURE: PRODUCTION POTENTIAL

Report by Dr. Abebe Getahun for this study.

### Overview

Despite the probable reduction in habitat diversity in irrigation canals, they are able to support various levels of fish production. The habitat may not be as heterogeneous as the natural environment and may not be as productive as the latter. However, canals have been used for fish production in many parts of the world and fish production from irrigation canals can be acquired through aquaculture or capture fisheries. In many situations aquaculture may prove more appropriate than a capture fishery, because of the greater control possible over production and the confined nature of the production systems. Hence, far more fish per unit area can be produced through aquaculture than through capture fisheries. This is the type of fish production that is also recommended for the project area.

The average production of the canals in the project area could be, on the average, about 500 kg/ha/year, which is a very conservative estimate. The average production of fish from lakes is 200–250 kg/ha/yr, whereas the potential production from intensive aquaculture, even in low technology culture systems, can be as high as 1,500–2,000 kg/ha/yr. It is known that many irrigation systems in China now produce 300–350 kg/ha/yr of fish from extensive aquaculture using pens in canals. This system is particularly refined in some of the delta regions of China, where fish production can be as high as 1,350 kg/ha/yr. In Sudan the fish biomass in the minor canals of the Gezira irrigation system ranged from 50 kg/ha to 2,786 kg/ha, with an average of 660 kg/ha.

Perhaps the major constraint to aquaculture development in irrigation canals is that a continuous, preferably constant, flow of water is required throughout the culture period. This problem is irrelevant to the Megech-Seraba project as all canals will be maintained full all the time, except for periodic maintenance. This practice of producing fishes in an aquaculture system has an added advantage of reducing the pressure that would have been otherwise exerted on the natural fish stock of Lake Tana, thereby contributing to the conservation of the natural fish stock.

Aquaculture systems are broadly classified as extensive, semi-intensive and intensive on the basis of the financial, technological and managerial inputs to the system. Extensive aquaculture relies on natural food sources, primarily plankton and algae, as food for the fish. Natural populations of fish may be confined, or the numbers of a particular species enhanced by low-level stocking of the water body, and growth of the food source may also be encouraged by limited fertilization of the water. Management and financial inputs are small.

In semi-intensive culture, enclosures are stocked with seed fish, and other species are discouraged. Food is provided, in the form of low protein (10–30%) feedstuffs, to supplement the natural production of food stimulated by the use of fertilizers. Management inputs consist of fertilization, stocking seed fish and regular supplementary feeding. Financial inputs mainly consist of seed fish and low-grade feed. The costs are not high.

Intensive culture systems represent complete control by the farmer over all aspects of the production cycle. Complete, pre-manufactured feeds are provided. These are high (30–50%) protein diets, usually based on fishmeal. Additional management inputs often include grading of the fish during the production cycle, into groupings of similar sized fish, to enhance the efficient management of the stock. Financial inputs are high, feed usually being the greatest drain on resources, and, depending on the species being cultured, seed costs can also be significant.

Therefore, the most likely types of aquaculture that could be maintained in the project area are extensive and semi-intensive aquacultures as the intensive one would be expensive, more pollutant and difficult to be managed by farmers.

Cultured fish species in cages and pens include tilapias and catfishes, and these fish species are naturally found in Lake Tana and associated river systems. They are very tolerant of conditions of poor water quality (particularly high suspended solids and low dissolved oxygen), and their culture is well established in various parts of the world. Tilapias are perhaps the most versatile species, especially where derelict, high-salinity waters are concerned, and are also preferred for food. Catfish are carnivorous and may, therefore, require more expensive, high protein feeds. There are also culture species like carp but the possibility of using indigenous fish, rather than introductions, should never be overlooked.

The presence of fishes in the canals can also be used to protect vectors of some waterborne diseases like malaria as the fishes could prey upon the insects and their larvae.

### Estimated Fish Production Potential in the Project Area

The Megech-Seraba irrigation project is designed in such a way that it has main and secondary surface canals that will be appropriate for fish production. The total length of the main canal is 20.565 km. The total length of all types of secondary canals is 45 km. The width of the primary canals is 3-5 m (an average of 4 m width is considered) and that of the secondary canals is about 0.72-5.22 m (see Table below). Since the canals are trapezoidal, width was calculated for each secondary canal as (bed width + (2 x (1.5 x depth))). For example, for a bed width of 1.2 m and depth of 0.85 m, the width of the canal at the water surface would be  $1.2 + (2(1.5 \times 0.85)) = 3.75$  m. The mean and median width of the secondary canals would thus be 2.665 m and 2.38 m, respectively. The median appears to be more realistic to take it as average width of the secondary canals to find out the total surface area. The total available canal area in the project site will, thus, be about 18.936 hectares. Considering the suitability of the area for year long fish production, and experiences from other countries, it could safely be estimated that an average of 500 kg/ha/year could be harvested from the canals (this is a conservative estimate). Therefore, the total amount of fish that could be harvested from the canals, through an extensive culture system, could reach about 9,468 kg per year. This, in monetary terms, could be about ETB 104,500 per year, assuming that one kg of fish (tilapia or catfish) could be sold at a retail price of around ETB 11/kg (see calculations below).

#### Determination of Surface Area (main and secondary canals)

Length of primary canal = 20.565 km

Length of secondary canals = 45 km

Width at 0.18 m bed width =  $0.18 + (2(1.5 \times 0.18)) = 0.72$  (lowest)

Width at 1.74 m bed width =  $1.74 + (2(1.5 \times 1.16)) = 5.22$  (highest)

Mean = 2.665 m; Median = 2.38 m; SD = 1.21266; SE = 0.21437

Area of surface water for main canal will be  $20,565 \text{ m} \times 4 = 82,260 \text{ m}^2$

Surface area of secondary canals is  $45,000 \times 2.38$  (median) =  $107,100 \text{ m}^2$

Total surface area =  $189,360 \text{ m}^2 = 18.936 \text{ ha}$

#### Fish Production Potential

500 kg/ha/year

$18.936 \text{ ha} \times 500 \text{ kg} = 9,468 \text{ kg/yr}$  or about 9.5 t/yr

Fish Value

1 t retail value is about ETB 11,000

9.5 t = about ETB 104,500

#### Channel Dimensions (m)

Bed Width	Depth	Width at Surface
0.32	0.32	1.28
0.18	0.18	0.72
0.51	0.51	2.04
0.46	0.46	1.84
0.45	0.45	1.80
0.42	0.42	1.68
0.27	0.27	1.08
0.36	0.36	1.44
0.51	0.51	2.04
0.25	0.25	1.00
0.29	0.29	1.16
0.38	0.38	1.52
1.36	0.90	4.06
1.28	0.85	3.83
1.74	1.16	5.22
1.28	0.85	3.83
1.34	0.89	4.01
0.56	0.56	2.24

Bed Width	Depth	Width at Surface
0.56	0.56	2.24
0.97	0.77	3.28
0.97	0.77	3.28
1.57	1.05	4.72
1.56	1.04	4.68
1.01	0.81	3.44
0.66	0.66	2.64
1.03	0.82	3.49
1.03	0.82	3.49
0.51	0.51	2.04
1.01	0.81	3.44
0.48	0.48	1.92
0.97	0.78	3.31
0.63	0.63	2.52

## 7. Annex 7 - Rapid Health Appraisal

### ESIA REPORT ON MEGECH PUMP (SERABA) IRRIGATION & DRAINAGE PROJECT

#### *Rapid Health Appraisal of Megech and Ribb Areas*

#### TABLE OF CONTENTS

List of Figures .....	7-4
List of Tables .....	7-4
Abbreviations.....	7-5
<b>7.1 INTRODUCTION .....</b>	<b>7-7</b>
7.1.1 Authors	7-7
7.1.2 Background	7-7
7.1.3 Regulatory Framework	7-8
7.1.4 Rapid Health Appraisal	7-9
7.1.4.1 Objectives	7-9
7.1.4.2 Approach	7-9
7.1.4.3 Report Layout	7-10
7.1.5 The Project Areas	7-10
7.1.5.1 Megech	7-10
7.1.5.2 Ribb	7-10
7.1.5.3 Conditions in the Project Areas	7-10
<b>7.2 EXISTING HEALTH SITUATION .....</b>	<b>7-11</b>
7.2.1 Introduction	7-11
7.2.2 Vector-borne and Soil-related Diseases	7-12
7.2.2.1 Malaria	7-12
7.2.2.2 Intestinal Schistosomiasis	7-15
7.2.2.3 Urinary Schistosomiasis	7-15
7.2.2.4 Soil-related Intestinal Helminths	7-16
7.2.2.5 Visceral Leishmaniasis	7-17
7.2.2.6 Dracunculiasis	7-17
7.2.2.7 Other Vector-borne Diseases	7-17
7.2.3 Waterborne Diseases	7-18
7.2.3.1 Overview	7-18
7.2.3.2 Diarrhoeas and Cholera	7-18
7.2.3.3 Poliomyelitis	7-19
7.2.3.4 Water Chemistry	7-19
7.2.4 Other Diseases and Health Issues	7-19
7.2.4.1 Trachoma	7-19
7.2.4.2 Acute Respiratory Tract Infections	7-20

7.2.4.3	Tuberculosis	7-20
7.2.4.4	Hepatitis A	7-20
7.2.4.5	Sexually-transmitted Infections and HIV/AIDS	7-20
7.2.4.6	Zoonoses	7-21
7.2.4.7	Malnutrition	7-21
7.2.4.8	Accidents	7-21
7.2.4.9	Pesticide Poisoning	7-21
7.2.5	Health Services and Facilities	7-21
7.2.5.1	Organisation	7-21
7.2.5.2	Health Facilities in the Project Areas	7-22
7.2.5.3	Traditional Healers and Medicinal Plants	7-24
<b>7.3 PRELIMINARY IMPACT ASSESSMENT .....</b>		<b>7-24</b>
7.3.1	Overview	7-24
7.3.2	Predicted Health Impacts during Construction	7-27
7.3.2.1	Health and Safety Issues	7-27
7.3.2.2	STIs including HIV/AIDS	7-27
7.3.3	Predicted Health Impacts during Operation	7-28
7.3.3.1	Malaria	7-28
7.3.3.2	Intestinal Schistosomiasis	7-28
7.3.3.3	Urinary Schistosomiasis	7-28
7.3.3.4	Soil-related Intestinal Helminths	7-28
7.3.3.5	Visceral Leishmaniasis	7-29
7.3.3.6	Dracunculiasis	7-29
7.3.3.7	Other Vector-borne Diseases	7-29
7.3.3.8	Waterborne Diseases	7-29
7.3.3.9	Other Diseases and Health Problems	7-30
<b>7.4 MITIGATION MEASURES AND MONITORING .....</b>		<b>7-31</b>
7.4.1	Introduction	7-31
7.4.2	Construction Phase	7-33
7.4.2.1	Health and Safety	7-33
7.4.2.2	STIs and HIV/AIDS	7-33
7.4.3	Operation Phase	7-34
7.4.3.1	Introduction	7-34
7.4.3.2	Malaria	7-34
7.4.3.3	Intestinal and Urinary Schistosomiasis, Intestinal Helminths	7-35
7.4.3.4	Diarrhoeas	7-35
7.4.3.5	Trachoma	7-36
7.4.3.6	Acute Respiratory Tract Infections	7-36
7.4.3.7	Sexually-transmitted Diseases and AIDS	7-36
7.4.3.8	Malnutrition	7-37
7.4.3.9	Accidents	7-37
7.4.3.10	Pesticide Exposure	7-37
7.4.4	Health Monitoring and Evaluation	7-38
7.4.4.1	Overview	7-38
7.4.4.2	Malaria	7-42
7.4.4.3	Schistosomiasis and Intestinal Helminths	7-42
7.4.4.4	STIs and HIV/AIDS	7-43
7.4.4.5	Malnutrition	7-43
7.4.4.6	Accidents	7-43
7.4.4.7	Pesticide Exposure	7-43

7.4.5	Health Organisation and Strengthening	7-43
7.4.6	Costs and Financing	7-44
7.4.6.1	Construction Phase	7-44
7.4.6.2	Operation Phase	7-44
7.4.6.3	Institutional Strengthening and Training	7-45
<b>7.5</b>	<b>CONCLUSIONS .....</b>	<b>7-45</b>
7.5.1	Findings	7-45
7.5.2	Next Steps	7-46
<b>7.6</b>	<b>REFERENCES .....</b>	<b>7-47</b>
7.6.1	References in Text	7-47
7.6.2	Additional Health References relevant to Ethiopian Highlands, by Topic	7-48
7.6.2.1	Health, Hygiene, Drugs	7-48
7.6.2.2	Malaria	7-48
7.6.2.3	Schistosomiasis	7-49
7.6.2.4	Leishmaniasis	7-50
7.6.2.5	Trachoma	7-50
7.6.2.6	TB	7-50
7.6.2.7	Viral Diseases	7-50
7.6.2.8	HIV/AIDS	7-50
7.6.2.9	Nutrition	7-50
<b>7.7</b>	<b>APPENDIX 1 - PEOPLE AND ORGANISATIONS CONTACTED .....</b>	<b>7-51</b>
<b>7.8</b>	<b>APPENDIX 2 - ITINERARY .....</b>	<b>7-52</b>
<b>7.9</b>	<b>APPENDIX 3 - DATA .....</b>	<b>7-53</b>
7.9.1	Dembia Woreda	7-53
7.9.2	Fogera Woreda	7-54
7.9.3	Libo Kemkem Woreda	7-56
7.9.4	Appendix 4 - Maps	7-56

## LIST OF FIGURES

Figure 7-1: Settlement near a pond in Fogera Plain .....	7-11
Figure 7-2: Malaria incidence per 10,000 in Dembia Woreda by Kebele, 1-30 Sept. 2002.....	7-13
Figure 7-4: Outpatients waiting at Yifag Health Centre (Ribb area).....	7-14
Figure 7-5: Malaria attack incidence as recorded at the Health Post in Addis Betekristian (Ribb area) .....	7-15
Figure 7-6: Chuahit Health Centre (Dembia Woreda): well-equipped laboratory .....	7-16
Figure 7-7: Addis Betekristian Health Centre (Fogera Woreda): microscopic observations using sunlight for illumination due to lack of electricity .....	7-16
Figure 7-8: Boys around an unprotected well, Dembia project command area, 2010 .....	7-18
Figure 7-9: List of health facilities and population served, by kebele, in Fogera Woreda .....	7-23
Figure 7-10: Health Post at Bura within command area in Libo Kemkem Woreda (right bank of Ribb River) .....	7-23

## LIST OF TABLES

Table 7-1: Top Ten causes of Morbidity, Dembia Woreda, 2009-2009 .....	7-12
Table 7-2: Top Ten Causes of Morbidity, Fogera and Libo Kemkem Woredas in 2008-2009 (Ethiopian years July 2000-June 2001).....	7-12
Table 7-3: Medical Staff Composition, Dembia, Fogera and Libo Kemkem Woredas, 2009 .....	7-22
Table 7-4: Health Facilities in and near Project Areas.....	7-22
Table 7-6: Summary of Foreseeable Health Impact Issues associated with Project Construction and Operation .....	7-26
Table 7-7: Proposed Health Mitigation Measures, by Priority .....	7-32
Table 7-8: Proposed Health Monitoring Measures .....	7-39

## ABBREVIATIONS

ACT	Artemisinin Combined Therapy
AIDS	Acquired Immuno-deficiency Syndrome
ANRS	Amhara National Regional State
ARD	Agriculture and Rural Development
ARTI	Acute Respiratory Tract Infections
AsDB	Asian Development Bank
AWD	Acute Watery Diarrhoea
BoARD	Bureau of Agriculture and Rural Development
BoH	Bureau of Health
DA	Development Agent
ETB	Ethiopian Birr
ENIDP	Ethiopian Nile Irrigation and Drainage Project
EPA	Environmental protection Authority
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
HAPCO	HIV/AIDS Prevention and Control Office
HEW	Health Extension Worker
HIA	Health Impact Assessment
H&S	Health and Safety
HIV	Human Immunodeficiency Virus
ICB	International Competitive Bidding
IEC	Information, Education and Communication
IFC	International Finance Corporation
JICA	Japanese International Cooperation Agency
KAP	Knowledge, Attitude and Practice
LLIN	Long-lasting Insecticidal Net
m asl	metres above sea level
MoH	Ministry of Health
MoWE	Ministry of Water and Energy (formerly MoWR)
MoWR	Ministry of Water Resources (now MoWE)
MPIDP	Megech Pump (Seraba) Irrigation and Drainage Project
NAC	National AIDS Council
NTD	Neglected Tropical Disease
OP	Operational Policy
PEPFAR	President's Emergency Plan for AIDS Relief
PLWHA	People living with HIV and AIDS
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
RDT	Rapid Diagnostic Test
RHAPCO	Regional HIV/AIDS Prevention and Control Office
RIDP	Ribb Irrigation and Drainage Project
SAFE	Surgery, Antibiotics, Facial cleanliness and Environmental improvement
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
TB	Tuberculosis
TBD	To be determined
USD	United States Dollar



VL	Visceral Leishmaniasis
WB	World Bank
WHO	World Health Organisation
WorHO	Woreda Health Office
WPIT	Woreda Project Implementation Team
WUA	Water Users Association

# ESIA REPORT ON MEGECH PUMP (SERABA) IRRIGATION & DRAINAGE PROJECT

## *Rapid Health Appraisal of Megech and Ribb Areas*

### 7.1 INTRODUCTION

#### 7.1.1 Authors

Public Health Specialist:

Dr. Pierre Gazin  
Faculty of Medicine, University of Marseilles, France  
Email: <gazin@mpl.ird.fr>, tel: +33-553-531822

Health Assistant:

Solomon Kibret  
Malaria Researcher and Health Research Coordinator, International Water Management Institute,  
Addis Ababa  
Email: <s.kibret@gmail.com>, tel: 0911-652-978

ESIA Team Leader, responsible for report expansion and editing:

James Ramsay  
Environmental Specialist, BRLi, France  
Email: <jramsay@horizon.bc.ca>, tel: 0910-196-376

#### 7.1.2 Background

Two irrigation and drainage schemes are proposed on the floodplain surrounding Lake Tana, Amhara National Regional State, Ethiopia. These schemes aim to transform the existing largely subsistence agricultural systems into commercial smallholder farming. The two areas are similar in terms of environmental, social and health conditions, and can be considered together in terms of health assessment.

The proposed irrigation schemes will alter the environment, primarily as a consequence of supplying water to the land during the dry season and thereby improving conditions for some diseases and their vectors. In addition, the new agricultural practices will lead to increased contact between human beings and water or wet soils. Such changes can affect human health (see, e.g., Keiser *et al.* 2005). At the same time, the economic and social benefits which the schemes are intended to bring are likely to be associated with significant *improvements* in health conditions.

Both the project's Environmental and Social Management Framework (ESMF: World Bank 2007) and the Terms of Reference (TOR) for the Environmental and Social Impact Assessment (ESIA) emphasise the risks to human health of the proposed projects, with a focus on water-related diseases, especially malaria and schistosomiasis. Initial fieldwork by the ESIA study team in 2008 confirmed the existence of these irrigation-associated health hazards.

In addition to the risk of worsening malaria and schistosomiasis due to the improved and expanded habitat typically provided by irrigation projects<sup>1</sup>, the projects will create or intensify other health hazards. These include:

- Health and safety risks to workers (and sometimes the public) during construction.
- Transmission of sexually-transmitted diseases to/from the construction work force, especially HIV/AIDS, and subsequently at market centres.
- Changes in health and nutrition status of any groups disadvantaged by the projects, either through reduced access to food resources (such as river fish), or lowered economic status, or disruption of social support networks and relationships, or changes in living conditions (especially worsened water and sanitation status). Note that any and all of these processes can be caused by resettlement as well as a result of changes in land tenure, farming practices, and social organisation associated with the irrigation scheme.
- Use of pesticides.
- Health and safety risks to workers on commercial farms within the command areas.
- Changes in household water supply availability and quality, and/or changes in sanitation.
- Other vector-borne diseases, such as Leishmaniasis.
- In addition, there may be risks from other processes such as, for example, blooms of toxic cyanobacteria in the Megech Dam or Ribb Dam reservoirs if they eutrophicate.

It is clear that the projects could have significant human health and social impacts and will require an appropriate level of response built-in to the Environmental and Social Management Plans (ESMPs). At the same time, it is important to realise that health is not a direct result of environmental conditions: increases in pathogens, vectors or intermediate hosts do not inevitably result in more disease. The determinants of human health are multifactorial: the existing poverty, low educational levels and behavioural norms of the population contribute to a poor health situation, but improved general education, infrastructure - in particular roads - and incomes are major items associated with better health. Prevention and treatment can completely modify the health situation.

This Rapid Health Appraisal describes the present situation in the communities living in and near the areas with special consideration of water related diseases, health facilities, foreseeable changes and possible mitigation measures for negative impacts.

### 7.1.3 Regulatory Framework

In Ethiopia, health is the responsibility of the Ministry of Health. Relevant Ethiopian laws and regulations include:

- Health Policy, 1998
- Public Health Proclamation No. 200, 2000
- Special Decree for Pesticides Registration (Proclamation No. 20, 1990)
- Waste Handling and Disposal Guideline, 1997
- Labour Proclamation No. 42, 1993
- Environmental Protection Policy of Ethiopia, 1997
- Environmental Impact Assessment Proclamation No. 299, 2002
- Environmental Impact Assessment Guideline Document, EPA, 2000
- Water Resources Management Policy and Water Resources Management Proclamation No. 197, 2000

Relevant World Bank policies and guidelines include:

- Operation Policy: OP 4.01 *Environmental Assessment*, 1999, together with numerous supporting Bank Procedures (BP), guidelines and manuals including Environmental Assessment Sourcebook Update No. 18 (July 1997) *Health Aspects of Environmental Assessment*

<sup>1</sup> Key reference: Birley, M. 1991 - Guidelines for Forecasting the Vector-borne Disease Implications of Water Resources Development. PEEM Secretariat, WHO, Geneva (2<sup>nd</sup> ed.)

- Operational Policy: OP 4.09 *Pest Management*, Dec. 1998, together with supporting Bank Procedures and guidelines

There is an extensive literature on health impact assessment (HIA) and on the health impacts of dams, reservoirs and irrigation schemes. The most recent guidance on HIA methodology from the World Bank Group is:

- *Introduction to Health Impact Assessment*, International Finance Corporation (IFC), 2009

Additional guidance is available from, in particular, the World Health Organisation (WHO).

These policies, laws, regulations and guidelines establish a clear requirement for assessment of the possible health effects of development projects in Ethiopia, especially where the projects are likely to modify environmental and social conditions. This requirement is reflected in the Environmental and Social Management Framework (ESMF) for the Ethiopian Nile Irrigation and Drainage Project (ENIDP) (World Bank 2007), and subsequently in the Terms of Reference for the Environmental and Social Impact Assessment (ESIA) of the Megech, Ribb and Anger projects, of which this appraisal forms a part.

## 7.1.4 Rapid Health Appraisal

### 7.1.4.1 Objectives

Given the importance of the health aspects of the study, the study team staffing was adjusted after submission of the Inception Report to upgrade the resources available for health impact assessment. This allowed the implementation of a rapid health appraisal (or "rapid health risk assessment"<sup>2</sup> or "limited in-country health impact assessment"<sup>3</sup>) of the two Lake Tana projects with the objectives of:

- Identifying health hazards;
- Identifying and disaggregating the population at risk;
- Assessing the potential health impacts on each vulnerable group (community vulnerability);
- Reviewing the capabilities of the health services<sup>4</sup>.

Typically such initial studies are followed by a process to develop appropriate health risk management responses in coordination with the concerned health authorities, including (i) changes in project design to avoid and control health impacts (designs, layouts, operating methods, organisational aspects), (ii) support to the health services to safeguard and improve health, and (iii) a health monitoring plan for inclusion in the project's Environmental Management Plan (EMP). In this case, recommended next steps are given in Section 7.5.2 of this report.

### 7.1.4.2 Approach

Following office-based research and preparation, fieldwork was carried out between 14 and 20 October 2009 in both project areas (see Itinerary at Appendix 2). Methods and techniques adopted included:

- Review of the literature dealing with health issues in the region.
- Review of relevant Ethiopian environmental and health legislation.
- Visit to the project areas to (i) contact relevant health authorities at regional and woreda level, (ii) hold meetings with key informants such as local health officials and health facility staff, and (iii) observe local conditions (environmental and social).
- Inspection of health facilities implementing typical daily tasks and activities in both project areas.

The appraisal team consisted of (i) a French physician (medical doctor) specialising in tropical diseases, and (ii) an Ethiopian health assistant (malaria researcher and health research coordinator based at the International Water Management Institute's Addis Ababa office (IWMI))<sup>5</sup>.

<sup>2</sup> See p4 of World Bank (1997) EA Sourcebook Update 18 - Health Aspects of Environmental Assessment

<sup>3</sup> See p11 of IFC (2009) Introduction to Health Impact Assessment

<sup>4</sup> This procedure is an adaptation of the Asian Development Bank's "Initial Health Examination": see AsDB (1992) - *Guidelines for the Health Impact Assessment of Development Projects*

<sup>5</sup> Subsequently appointed as a lecturer in public health at AAU.

People and organisations contacted are listed at Appendix 1. The appraisal team's itinerary is given at Appendix 2.

#### 7.1.4.3 Report Layout

This report has four main sections: following this Introduction, these are:

- Existing Health Situation: this describes the existing health hazards in the two project areas, together with the Health Services and Facilities (the system and facilities for delivery of health services). Data are given in Appendix 3.
- Preliminary Impact Assessment: this provides a description of the potential health risks associated with the two projects, during both construction and operation.
- Mitigation and Monitoring: this proposes a number of measures to mitigate the health risks associated with the project, together with an outline of the monitoring requirements.
- Conclusions: this section summarises the main conclusions of the appraisal, and sets out a number of steps for further development and implementation of the health management aspects of the two projects.

The report also includes References including a short health bibliography, and Appendices including persons and organisations contacted and consulted, an itinerary, data, and maps.

### 7.1.5 The Project Areas

The two project sites under study are the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) and the Ribb Irrigation and Drainage Project, together with the Ribb Dam, reservoir and diversion weir.

#### 7.1.5.1 Megech

The Megech project is close to the Lake Tana shore south of the Gonder - Bahir Dar road and east of the Gonder - Gorgora road (Map 1 in Appendix 4).

The full Megech irrigation and drainage project comprises four sub-schemes. The MPIDP is the first to be developed and lies fully in Dembia Woreda of North Gonder Zone. Some 4,000 ha will be developed for dry-season irrigation using water pumped from Lake Tana.

Eight kebeles are included fully or partially in the command area of the Megech project: Aberjeha, Achera Mariam, Arabia Adisge, Chankua, Debre Zuria, Guramba Bata, Jangua Mariam, and Seraba Dabelo (source: TAHAL-CECE, MPIDP final Feasibility Study, Feb. 2010).

Note that, separately, a dam will be constructed on the Megech River to regulate flows and provide dry-season irrigation to areas downstream of the dam and upstream of the pumped project.

#### 7.1.5.2 Ribb

The Ribb project is planned to benefit a number of Kebeles in two Woredas of South Gonder Zone, namely Libo Kemkem and Fogera (Map 2 in Appendix 4). The irrigated area may reach some 14,000 ha on both banks of the Ribb River, depending on the irrigation technologies adopted. Water will be supplied from a reservoir behind the Ribb Dam, which is now under construction. Water will be released from the reservoir into the Ribb River, and diverted at a weir 28 km downstream into irrigation canals on each side of the river.

The project's design is at feasibility stage; 14 kebeles will be partly or fully within the command area in Libo Kemkem Woreda - Agita, Angot, Bambiko, Bira, Birkute, Bura, Estifanos, Genda-weha, Kab, Shamo, Shina-Tsion, Tibaga, Tizamba, Yifag, and 8 kebeles in Fogera Woreda - Addis Betekristian, Abwa Kokit, Diba Sifatra, Ribb Gabriel, Shaga, Tiwuha Zekena, Watambi, Wereta Zuria (source: Ribb Feasibility Study, Jan. 2010).

#### 7.1.5.3 Conditions in the Project Areas

Both command areas are very flat and partly flooded during the rainy season due to overflow from the rivers, a rise of the Lake Tana water level, and rainfall. Most soils are heavy black clays (vertisols) with poor drainage. Permanent wetlands and ponds are scattered throughout both areas.



**Figure 7-1: Settlement near a pond in Fogera Plain**

The populations living or using land in the proposed command areas are around 27,000 individuals at Megech and surroundings and 50,000 in or near the Fogera plain (Ribb). The population density is very high, around 300 inhabitants/km<sup>2</sup>. This density is near or at the limit for rural areas using only rainfed and recession cropping with very limited use of artificial fertilisers and no mechanisation. The cultivated area averages some 1.2 to 1.8 ha per household of 5 to 6 individuals. Farming is oriented to family subsistence and is risk-averse. Homesteads are close to standing water (Fig. 1).

Domestic drinking water is supplied from shallow wells, ponds and the lake. Wastewater is not collected. Latrines are uncommon.

The main health hazards are the vector-borne tropical diseases especially malaria, intestinal schistosomiasis and soil-related intestinal helminths. At this Latitude, the elevation of 1800 m asl is compatible with the cycles of transmission of these diseases, which are widely observed in the population. They are the principal diagnosis done in the health facilities, and the origin of the major part of the prescriptions.

The lack of permanent roads inside the two areas is of importance for health. During the rainy season and the beginning of the dry season - at least during six months each year - the only way to travel within the command areas is on foot, by donkey or horse, by bicycle, or by boat. Bicycles, motorcycles, horses and boats are high-value items and therefore are uncommon.

Professional health workers are rarely present inside the command areas, largely due to difficult access.

Electricity is present in few locations, but mobile phone service is available everywhere.

## 7.2 EXISTING HEALTH SITUATION

### 7.2.1 Introduction

This chapter summarises the existing health situation in the two project areas under the three main headings of Vector-borne and Soil-related Diseases, Waterborne Diseases, and Other Diseases and Health Issues. A final section outlines the Health Services and Facilities in the two areas.

**Definitions:** in this report, the following terms are used as defined below:

- *Health hazard:* a potential harm (i.e. malaria, accidents, malnutrition).
- *Health risk:* the probability that a health hazard will cause harm to a particular group of people.
- *Health impact:* any change in health risk that is reasonably attributable to the projects.
- *Morbidity:* negative health effects on a person caused by a health condition.
- *Mortality:* the number of people dying from a certain condition in a certain time.
- *Prevalence:* number of cases of a health condition in a population, expressed as a proportion or percentage.
- *Incidence:* measure of the risk of developing a health condition in a given time.
- *Intensity:* severity of an infection, typically by a parasite.
- *Hyperendemic:* high and continued incidence.

**Data:** health statistics collected from local health facilities and offices are given in Appendix 3. Data on the top ten causes of morbidity as supplied by the respective woreda health offices (WorHO) in Dembia (Megech area), Fogera and Libo Kemkem Woredas (Ribb area) are given in Tables 1 and 2.

**Table 7-1: Top Ten causes of Morbidity, Dembia Woreda, 2009-2009**

Rank	Disease	No. of Cases	%
1	Malaria	15,359	40
2	Intestinal parasites	4,902	13
3	Gastritis	3,513	9
4	Other helminthiasis	2,924	8
5	Unspecified nematodes	2,700	7
6	Diarrhoea	2,659	7
7	Acute respiratory tract infections	2,354	6
8	Skin infections	1,410	4
9	Rheumatism	1,272	3
10	Tonsillitis	1,089	3
	Total	38,182	

Source: Dembia WorHO

**Table 7-2: Top Ten Causes of Morbidity, Fogera and Libo Kemkem Woredas in 2008-2009 (Ethiopian years July 2000-June 2001)**

Rank	Fogera Woreda		Libo Kemkem Woreda	
	Disease	Cases in 2008 - 2009 (% of all cases)	Disease	Cases in 2 <sup>nd</sup> 1/4 2009 (% of all cases in year)
1	Malaria	26,674 (42)	Malaria (clinical)	6,538 (15)
2	Pneumonia	7,045 (12)	Malaria ( <i>P.f.</i> confirmed)	1,923 (4)
3	Diarrhoeal diseases	5,970 (10)	Diarrhoea (non-bloody)	1,144 (3)
4	Helminthiasis	2,174 (5)	Intestinal parasites	1,010 (3)
5	Acute upper respiratory tract infections	2,053 (4)	Acute upper respiratory tract infections	674 (3)
6	Acute bronchitis	1,920 (3)	Diarrhoea (bloody)	632 (1)
7	Infections of the skin and subcutaneous tissue	1,686 (3)	Pneumonia	519 (1)
8	Trachoma	1,616 (3)	Tonsiopharyngitis	517 (1)
9	Dyspepsia (gastritis)	1,374 (3)	Urinary tract infections	385 (1)
10	Tonsiopharyngitis	1,267 (2)	Unspecified causes of trauma / injury	349 (1)

Source: Fogera and Libo Kemkem Woredas 2009 Health Reports

## 7.2.2 Vector-borne and Soil-related Diseases

### 7.2.2.1 Malaria

According to the Amhara National Regional State Bureau of Health (BoH) annual report (as reported in Alemayehu 2008), 80% of the land of the State is malarial and 75% of the population is at risk of malaria infection. Malaria is responsible for 15-40% of hospital admissions, 7-30% of hospital deaths, and has a 10-25% case fatality rate.

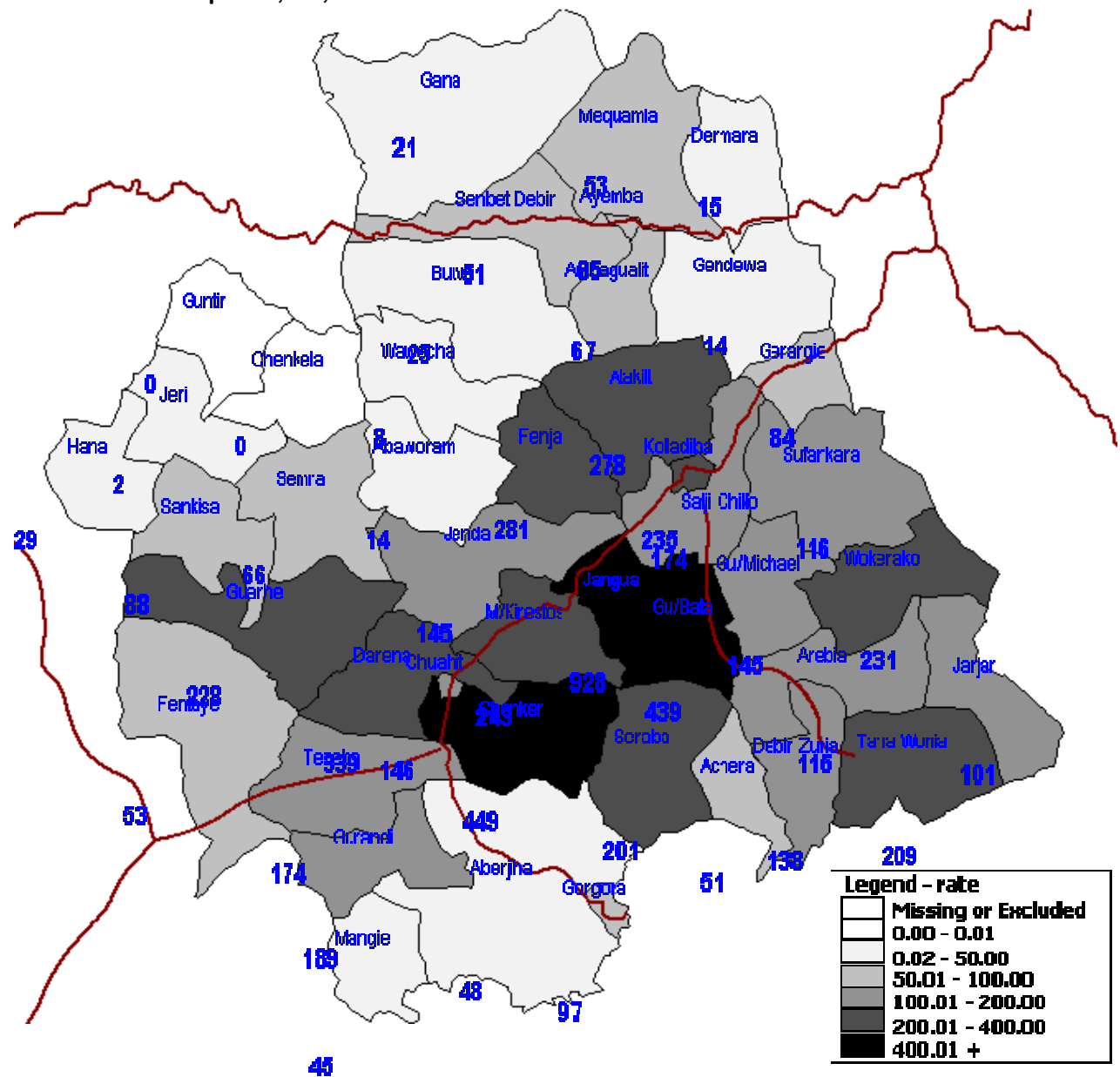
The disease is well known in both North and South Gonder Zones. The health officers in the health centres, health professionals and local inhabitants all confirmed that malaria is the leading public health concern in the Megech and Ribb areas. Malaria is present all the year round with a peak of attacks at the beginning of the dry season, from September to December (Figure 2). Incidence rates in and near the Megech project kebeles varied from 2% to over 9% in September 2002 (Figure 2; Appendix 3). Note that there may be significant under-reporting in some kebeles because patients may travel to better facilities in neighbouring kebeles.

The situation is classically described as hypoendemic malaria as a result of stable transmission at a low level. The more obvious aspect of this situation is the lack or weakness of acquired immunity against the *Plasmodium* in adults, and the observation of malaria attacks in individuals of all ages.

*Plasmodium falciparum* is the predominant species, responsible for about 60% of infections. *P. vivax* is the other *Plasmodium* present. The main vector, the mosquito *Anopheles arabiensis*, belongs to the complex *Anopheles gambiae* sensu lato. *An. gambiae* sl are various species of highly efficient malaria vectors. At the peak of transmission, the rate of infected females can be up 1%. These mosquitoes breed in puddles on the lake shoreline, pools of rainwater, and man-made pools of shallow, sunny and clean water.

The malaria transmission pattern changes to an epidemic once every 5 to 7 years, with a sudden peak in incidence. The reason for this well-described, episodic situation is probably the development of a larger than usual population of *Anopheles* mosquitoes due to a longer than usual rainy season, together with the receptiveness of human beings to the disease as a consequence of levels of transmission usually being lower.

**Malaria incidence per 10,000, Dembia**



**Figure 7-2: Malaria incidence per 10,000 in Dembia Woreda by Kebele, 1-30 Sept. 2002**

Source: Malaria Investigation Report (unpublished), JICA AmRIDS, 2010.



The present malaria control and prevention policy of Ethiopia comprises (i) vector control through indoor residual spraying with pesticides, (ii) long-lasting bed net distribution, and (iii) case management (chemotherapy). Chloroquine is used for the treatment of *P. vivax* attacks. For the last several years *P. falciparum* attacks have been treated with an Artemisinin Combined Therapy (ACT) after, if possible, a laboratory diagnosis (microscopic examination of thick blood film or Rapid Diagnostic Test (RDT)). The ACT is Coartem®, a highly effective combination of artemisinin and lumefantrine. The RDT is the Paracheck® test which can confirm the presence of *P. falciparum* but not of other malarial parasites; these require microscopy by experienced technicians.

In the public health centres and posts, at present RDT and malaria treatment are free of cost. However, the microscopic observations are not free (ETB 3 per sample). The choice between the two tests, microscope or RDT, depends on what is available in the particular health facility, and also on the clinical impression of the health workers. In case of a suspected *P. vivax* infection, microscopic examination is systematically used, if it is available.

At the Yifag Health Centre (right bank of Ribb River), the health study team observed the treatment of 249 malaria outpatients in only one day and of 700 malaria outpatients in one week (Fig. 3). This illustrates the importance of the disease, and also the difficulty of carrying out a formal laboratory test for each patient. Clearly, a large proportion of the treatments given is presumptive (based on observed symptoms, not on lab. diagnosis). The fact that treatment is free may be a cause of excessive demand.

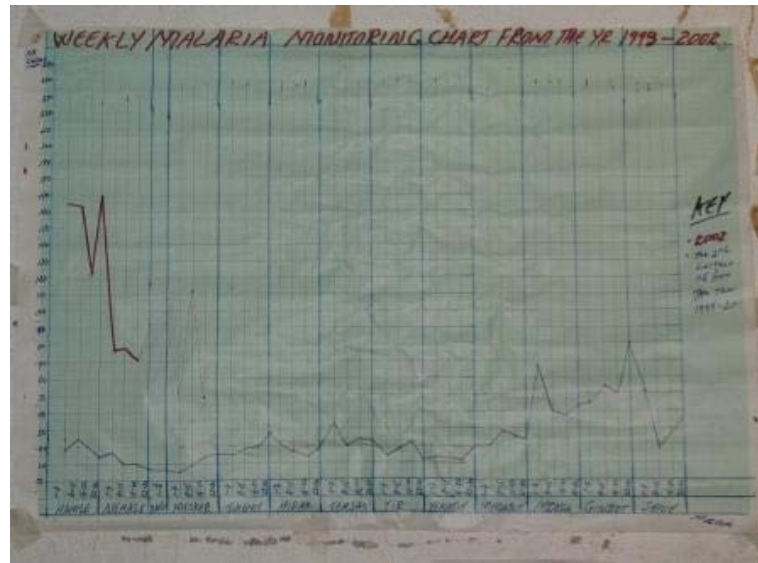


**Figure 7-3: Outpatients waiting at Yifag Health Centre (Ribb area)**

The Ethiopian National Malaria Control Programme has promoted the use of Long Lasting Insecticidal Nets (LLINS) to reduce contact between human beings and *Anopheles* mosquitoes. A large free distribution of LLINS has been done since 2005 in all the country including the surroundings of Lake Tana. Health workers are responsible for educating local residents as to their purpose and for promoting correct use. However, bednets appear to be used by few of the residents of the two command areas. Interviews with outpatients at Yifag Health Centre suggested that the bednets are worn out since they have been used for four years without replacement; the inhabitants expect replacement of bednets at least every two years. Despite average numbers of bednets per household being reported as 1.9 in the Megech command area and 2 in the Ribb command area, their number is not sufficient for use by each individual (typical household sizes are 6 persons at Megech and 5 at Ribb)<sup>6</sup>. Moreover, the use of bednets is never easy in a poor household without standard beds and mattresses and with the frequent presence of smoke inside the houses. It is also possible that part of the population does not accept that bednets will reduce the chances of contracting malaria; the appraisal team observed bednets being used for non-intended purposes such as infant slings and wrapping goods.

<sup>6</sup> These data are from the respective household surveys carried out by the projects' design consultant in 2008.

In summary, malaria is a major problem all the year round for individuals of all ages living in the Dembia and Fogera plains. Its incidence shows an annual increase from September to December, and periodically malaria outbreaks as a local epidemic (Fig. 4).



**Figure 7-4: Malaria attack incidence as recorded at the Health Post in Addis Betekristian (Ribb area)**

#### 7.2.2.2 Intestinal Schistosomiasis

Intestinal schistosomiasis or bilharziasis (*Schistosoma mansoni* infection) is present around Lake Tana, as elsewhere throughout much of the country. In Ethiopia most transmission sites are between 1300 and 2000 m asl. Some ponds, puddles and the lake shoreline are infested with *Biomphalaria pfeifferi*, the parasite's major intermediate host. These snails are not present in rapidly flowing streams or rivers. Various relatively recent studies carried out in the surroundings of Lake Tana have evidenced prevalence rates of intestinal schistosomiasis of 20% to 50% of children attending schools (see, e.g. Jemaneh 2000). These infections are most often light or moderate.

Cases of intestinal schistosomiasis are diagnosed in the Health Centres in the Megech and Ribb areas. These diagnoses are done clinically in some Health Centres and with confirmation by microscopic examination of stool samples in other Centres, according to the equipment available and capacity of the staff. Since the symptoms of moderate infections of *S. mansoni* are similar to those of intestinal helminth infections or of repetitive diarrhoeas, it is probable that the prevalence of intestinal schistosomiasis in the local populations is underestimated. This can be confirmed by specialised surveys (stool analysis of representative samples of the population), which should be carried out prior to commissioning of the two irrigation schemes.

#### 7.2.2.3 Urinary Schistosomiasis

In Ethiopia, *Schistosoma haematobium* infections (urinary schistosomiasis) are confined to lowlands below 800 m asl in the western part of the country and in the low Awash Valley (Central Ethiopia). The rareness of the foci is largely due to the non-susceptibility of most bulinine snails to the Ethiopian strain of the parasite, and maybe also to the relatively low water temperatures in the Highlands. However, the snail host/parasite relationships and the dynamics of the snail populations are not easy to predict.

According to available literature and discussions with local health staff, at present urinary schistosomiasis is not observed around Lake Tana. However, the water-related environmental changes which will be caused by the projects, especially the construction of many 100 km of secondary and tertiary canals and drains in each irrigation scheme, could result in new biotopes (habitat) favourable to *Bulinus* snails. If this occurs, and if *S. haematobium* is introduced to the area by infected people from the Lowlands, the disease could emerge around the lake. Consequently, as for intestinal schistosomiasis, a specialised survey prior to commissioning of the two schemes is recommended.

#### 7.2.2.4 Soil-related Intestinal Helminths

According to various published surveys, intestinal soil-transmitted helminths ("worms", including for example *Ascaris*, *Trichuris*, hookworms) infect a large part of the population living around Lake Tana. Considering the low level of sanitation, especially the small number of households with latrines and effective use of them, the high prevalence of intestinal helminths infections is not surprising. Most residents defecate in fields. Human faeces are present in some places near homesteads and also in cultivated plots. These open deposits allow the continuation of the parasites' lifecycles from human intestinal tracts onto the wet soils and plants. Human infestations result from ingestion of the larvae on contaminated food or, for hookworms, through the skin of the feet and legs of farm workers and children.

Intestinal helminthic infections are one of the most frequent diagnoses done in the health facilities of the two project areas. The diagnoses are usually done by clinical examination only; stool examinations cannot be done in all health facilities (Figs. 5, 6). It is possible that some abdominal pains or weakness due to other causes are explained as intestinal helminthic infections. Some confusion with intestinal schistosomiasis can also appear, including the fact that these various infections can be present in the same individual at the same time, with similar symptoms. The same stool examination as for the intestinal schistosomiasis survey (see 2.2.2 above) could provide exact data on the current situation of helminthic infections in the project areas.



**Figure 7-5: Chuahit Health Centre (Dembia Woreda): well-equipped laboratory**



**Figure 7-6: Addis Betekristian Health Centre (Fogera Woreda): microscopic observations using sunlight for illumination due to lack of electricity**

### 7.2.2.5 Visceral Leishmaniasis

Visceral leishmaniasis (VL) is present around Lake Tana. Its vectors, sandflies, are not associated with wet environments, but they are present on hills not far away from the project areas. Their breeding places are dry holes in rocks or between stones, sometimes in the burrows of rodents. Six cases of VL were reported from Dembia Woreda in 2009, possibly associated with migrant labour returning from lower elevations.

An epidemic of VL occurred in Libo Kemkem and Fogera woredas in 2005, probably due to multiple introductions of the parasite by agricultural labourers returning from seasonal work on the border with Sudan (Alvar *et al.* 2007, Herrero *et al.* 2009). More than one species and several genotypes of *Leishmania* were identified in human and canine specimens. Community-based data collected in October 2005 suggests that the disease may have been present in 2003 and 2004, but a large proportion of the patients who became ill may have died before their disease was recognised. In 2005 the Addis Zemen Health Centre (AZHC), maintained by Médecins sans Frontières-Ethiopia, Operational Centre Barcelona-Athens, began offering diagnosis and treatment for VL. 2,543 VL patients were treated at AZHC between May 2005 and December 2007, of whom 4% died.

The epidemic transformed into a sustained endemic situation in 2007. When new cases of VL are suspected by health workers in the project areas the patients are sent for confirmation and treatment to the AZHC or one of the district hospitals in the Region.

As in other tropical and sub-tropical regions, the lowered immune response of individuals infected by HIV can increase their susceptibility to VL and mortality when infected.

### 7.2.2.6 Dracunculiasis

Dracunculiasis, also known as guinea worm disease, is caused by the large female of the nematode *Dracunculus medinensis*. This emerges painfully and slowly from the skin, usually on the lower limbs. Persons become infected by drinking water from stagnant sources contaminated by copepods (water fleas) that contain immature forms of the parasite. Since 1986, a worldwide programme of eradication of dracunculiasis has resulted in a dramatic reduction of its incidence. Some cases are probably still observed in Ethiopia but not in Amhara State. Health workers in and around the project command areas do not report cases of this spectacular infection. Unknown cases are highly improbable.

### 7.2.2.7 Other Vector-borne Diseases

**Yellow fever:** this is a viral disease which is transmitted from one primate to another, including humans, by mosquitoes of the genus *Aedes*. The infection is endemic in monkeys living in the humid lowland areas of western Ethiopia. It can spread along river valleys below around 1600 m asl. Epidemics of yellow fever in the Omo and the Didessa valleys between 1959 and 1966 resulted in a high human mortality rate. The epidemics stopped at the foot of the Ethiopian Plateau. Since 1966, no case of the disease has been reported.

Epidemics need a dense population of anthropophilic *Aedes* and a receptive non-immune human population. The strictly human-related *Aedes* like *Ae. aegypti* are the main vectors. They use small artificial collections of water as breeding places (for instance paint pots, old tyres or tin cans). The domestic storage of water is the main cause of *Aedes* proliferation. One of the better protections against *Aedes* is to create easy access to drinking water, thereby reducing the need to store it. At the present time, *Ae. aegypti* is not observed around Lake Tana.

**Dengue:** other viral diseases such as dengue fever, which also use *Aedes* spp. as vectors, are not reported from around Lake Tana at present.

**Human African trypanosomiasis:** this disease, commonly known as "sleeping sickness", is endemic in the southern and south-western parts of Ethiopia. Susceptible areas are the hot lowlands bordering the Sudanese plains at elevations up to 500 m asl, and some river valleys. These areas are typified by savannah woodland vegetation where the tsetse fly vectors find their habitats. These range from thick riverine forests and high grass savannah to low tree savannah and the bamboo vegetation zones.

Currently few cases are reported in Ethiopia. The highlands and the Ethiopian plateau are non-endemic zones since tsetse flies cannot live and reproduce at this elevation in areas with virtually no natural vegetation and unfavourable soil conditions.

**Onchocerciasis:** this is endemic in the south and north-western parts of Ethiopia. The vectors are blackflies of the genus *Simulium*. The larvae of these flies need fast flowing and shaded rivers and streams in forests and tree-fringed savannas. The fast flowing streams of the Ethiopian highlands are not suitable habitats for *Simulium* probably because of the relatively low average temperatures and organic content of running waters.

Onchocerciasis is common in low-elevation woredas of North Gonder Zone such as Metema and Quara but has not been reported from the Lake Tana area by the health facilities of Amhara National Regional State.

## 7.2.3 Waterborne Diseases

### 7.2.3.1 Overview

"Waterborne diseases" caused by protozoa, bacteria or viruses are common in the Ribb and Megech areas, as elsewhere in the world where there is no access to abundant clean water (Fig. 7) and no safe disposal of human waste and wastewater. However, these infections are rarely a direct result of unsafe water. Most often they result from contamination of food by traces of stools from dirty hands or from flies flying from animal and human faeces to human food (see Section 7.2.2.4 above). In fact, these diseases are a result not of an excess of water but of a *too little* access to clean water, a lack of hygiene (especially of soap and washing hands), and inadequate protective food storage.



**Figure 7-7: Boys around an unprotected well, Dembia project command area, 2010**

### 7.2.3.2 Diarrhoeas and Cholera

According to information from the Woreda Health Offices, and as confirmed by households during the household surveys<sup>7</sup>, diarrhoea stands second or third among the most important health problems in the project areas. The number of cases is probably higher than reported because everywhere in the world diarrhoeas are often treated at home by traditionally practices, or neglected. Neglected diarrhoeas are one of the main causes of infant deaths in poor countries.

<sup>7</sup> These surveys were carried out by the project's design consultant in 2008.

Amhara BoH is distributing water treatment chemicals (named "Agar<sup>®</sup>" and WaterGuard<sup>8</sup>) to some villages in areas with limited access to safe drinking water. This may have an impact on the viral or bacterial pathogens in the water but not on the swarms of flies and on food contamination. Significant changes in the incidence of diarrhoea can come only from a substantial change in access to domestic water and transformations in hygiene and food management behaviour. The huge number of flies will not be reduced by the use of latrines due to the presence of livestock droppings everywhere around the houses.

Because acute bacterial or viral diarrhoeas are frequent events generally easy to treat by oral rehydration, in many cases they can be treated without recourse to health facilities. The challenge for health professionals is to ensure that preventive measures (hygiene) and curative measures (oral rehydration) are understood and practiced at household level, especially by mothers with small children.

An outbreak of acute watery diarrhoea (AWD) occurred in temporary community shelters for flood victims along the Ribb River in Libo Kemkem Woreda in 2008. The ANRS health authorities do not consider this to have been cholera (in Ethiopia, cholera is reported as AWD).

### 7.2.3.3 Poliomyelitis

Human infection by the poliomyelitis virus ("polio") results from drinking contaminated water. Worldwide mass vaccinations against the disease have resulted in near-extinction of the virus, and Ethiopia was poliomyelitis-free for four years until December 2004. Then, some cases in infants and children were reported in three regions, including Amhara State. Risk factors that may have facilitated spread of the outbreak include gaps in vaccination coverage, interruption of the cold chain system, gaps in surveillance performance, high population mobility, poor environmental sanitation, crowded living conditions and unsafe drinking water. House-to-house investigation and vaccination campaigns resulted in a new interruption of transmission.

According to local health professionals, no cases of poliomyelitis have been reported in the Megech and Ribb river areas. For a sustainable result, immunisation campaigns must be continued diligently with the objective of reaching every child both now and in the future, combined with improved hygiene and sanitation behaviours.

### 7.2.3.4 Water Chemistry

Local residents complain about the quality of their domestic water supplies - taste, colour, smell etc - but the health study team did not obtain any evidence that local residents are being negatively affected by water chemistry (e.g. kidney problems due to excessive sodium, or poisoning due to arsenic).

## 7.2.4 Other Diseases and Health Issues

### 7.2.4.1 Trachoma

Trachoma, a chronic eye infection by *Chlamydia* bacteria, is hyperendemic in a large part of Ethiopia including the rural areas around the Lake Tana. The 2006 national blindness and low vision survey (Yemane Berhane *et al.* 2006) suggests that Ethiopia is the most trachoma-affected country in the world (Emerson *et al.* 2008). Various clinical aspects of the infection can be observed in up to 90% of the children and adults in the rural areas of the country. Amhara National Regional State is disproportionately affected by trachoma, bearing an estimated 45% of the national trichiasis burden and with approximately 1 in 20 adults suffering from trichiasis (Berhane *et al.* 2006), and with some 645,000 persons requiring corrective trichiasis surgery in the State (Emerson *et al.* 2008).

The disease is associated with the presence of flies, which transmit *Chlamydia* from one individual to another. The lack of hygiene, of clean water, of soap for washing the face, and contact with dust, especially in houses with mud floors and wattle and daub walls<sup>9</sup>, all contribute to the transmission and development of the disease. Trachoma is not a result of an excess of water or of a wet environment; it is linked to a lack of hygiene, to poverty and to frequent contact with flies.

<sup>8</sup> A dilute bleach product developed by the Center for Disease Control and Prevention and the Pan American Health Organization.

<sup>9</sup> Wattle and daub: sticks and mud.

In Ethiopia, trachoma control is through the SAFE strategy (Surgery, Antibiotics, Facial cleanliness and Environmental improvement (water and sanitation)). This strategy includes the construction and use of low-cost latrines, after community mobilisation. The Federal Ministry of Health aims to eliminate the worst form of the disease, blinding trachoma, in Amhara State by 2012. This is possible if, in addition to latrine promotion, there are complementary actions on hygiene education, behavioural change, and the provision of medical care. The ANRS BoH is planning an integrated malaria and trachoma control programme, with assistance from the Carter Centre.

In the long run, mechanisation and commercialisation of farming, allowing a reduction in livestock numbers, could be an indirect action against trachoma.

#### 7.2.4.2 Acute Respiratory Tract Infections

In the areas of the irrigation schemes and in their surroundings, acute respiratory tract infections (ARTI), including bronchitis and pneumonia, rank among the top three causes of morbidity together with malaria and diarrhoea. Low temperatures, especially during the night, the poor housing conditions, the indoor fires of cow dung and wood without evacuation of the smoke are cumulative elements contributing to a high incidence of ARTI. In infants and children, repetitive ARTI can lead to malnutrition through repetitive fever attacks and exhaustion. Without efficient treatment, ARTI is one of the main causes of death of all age groups.

In the project areas, diagnoses of ARTI are only done by clinical examination. Treatments - antibiotics and cough mixtures - can be bought at the health facilities or drug shops. However, despite the use of generic drugs, they can be expensive in relation to the low incomes of the population. The best prevention methods are improvements in housing and clothing through poverty alleviation.

#### 7.2.4.3 Tuberculosis

Persistent respiratory symptoms may be indicative of pulmonary tuberculosis ("TB"). In 2009 local health informants told the ESIA medical team that diagnoses cannot be made in outlying health facilities and that suspected TB patients are sent to regional hospitals for diagnosis and treatment in accordance with protocols recommended by MoH's National TB Programme. For this reason, tuberculosis cases are not reported by the Woreda-level health facilities around Lake Tana. However in 2010 the ANRS BoH informed the study team that TB diagnosis and treatment are carried out at Health Centre level, i.e. in the woredas.

According to the medical literature (Getahun & Argaw 2001), the disease is present in South Gonder region with a prevalence of around 1%. At national level the prevalence is about 579/100,000, or about 0.6% (Yimer *et al.* 2005). A national TB prevalence survey is planned for 2010. This should clarify the TB situation in the Lake Tana region, and also cast light on the role played by HIV infection.

As in other parts of the world, TB patients are often ostracised. The sick are ashamed of the possible diagnosis. The time between the beginnings of the symptoms and visiting a health facility can be long, with delays of many months before hospital treatment is provided. Apparent clinical improvement after the intensive phase is sometimes a reason for defaulting on courses of treatment. All these elements, together with the high level of HIV/AIDS, contribute to the importance and perpetuation of the disease.

#### 7.2.4.4 Hepatitis A

Various studies in Ethiopia show that hepatitis A infection is widespread (Edemariam Tsega *et al.* 1990). The infection starts early in life. Antibodies (anti-HAV) can be found in 50% of the population before 5 years of age, increasing rapidly with age and becoming universal after the age of 15. Socioeconomic factors play a major role in its transmission.

No clinical data on hepatitis were included in available WorHO reports in the project areas.

#### 7.2.4.5 Sexually-transmitted Infections and HIV/AIDS

Ethiopia is amongst those countries where sexually transmitted infections (STIs) are highly prevalent. However, information on the seroprevalence rates of STIs, except for HIV infection, is scarce. Modelled data suggest a rise in prevalence of HIV in rural areas of Ethiopia (2003: 2.6% of all individuals) and in all the country (2003: 4.4%), but a stable or declining prevalence from much higher levels in the urban areas (Addis Ababa, 2003: 14.6%) (MoH 2003). Deaths due to AIDS brought life expectancy down from 53 to 46 in 2001 (MoH 2004). Transmission is largely heterosexual (87%), with about 10% mother to child and some evidence of involvement of sharp instruments (e.g. for tattooing, ritual tooth removal, circumcision), especially in rural areas (MoH 2004).

According to the National AIDS Surveillance reports, HIV infection prevalence is 2.3% in Gonder zone. However, in 1995 rates of 23.4% and 15.1% of HIV seropositivity among antenatal clinic attenders and rural women respectively were reported, and considered to be an indicator of the rapid progression of the HIV epidemic in the area (Aseffa *et al* 1998). A more recent survey in Gonder (Kassu *et al* 2004) has shown a seroprevalence of 9% of HIV infection in antenatal clinic attendees, and 2% for *Treponema pallidum*, the agent of syphilis and also of non-sexual infections.

For women, syphilis and genital chlamydial infection are associated with young age of first marriage, a low gravidity rate, and the number of husbands. The usual association with HIV infection is observed.

In the Megech area, the health staff of Chuahit Health Centre informed the appraisal team about a "high HIV prevalence between 2007 and 2008", but could not provide any supporting statistics. No data on HIV were available from the Fogera plain.

#### 7.2.4.6 Zoonoses

The Bureau of Health in Bahir Dar describe the zoonoses situation as follows: rabies: endemic; avian flu: on watch; African Rift Valley fever: none - elevation too high; bovine TB: present; brucellosis: probable, but no diagnostic capability.

#### 7.2.4.7 Malnutrition

According to various surveys carried out in South Gonder region, the overall malnutrition rate of preschool and school children is high (Amsalu & Asnaku 2006; Yusuf 2000). The prevalence rates of underweight, stunting and wasting are between 30% and 50%. The weight for age and the weight for height indices are especially low. These data are evidence of chronic malnutrition (stunting). Other surveys (Belachew & Nekatibeb 2007; Worku *et al.* 2009) show a decrease of this chronic malnutrition but not of acute malnutrition. As is usually observed in developing regions, there is a high mortality rate among severely malnourished patients despite hospital admission for therapeutic feeding.

Not surprisingly, income appears the most important factor in determining nutritional status. The amount of land available to each farming family is critical in terms of income levels. Productivity is also important, and can increase with changes in farming practice. Further important factors are the knowledge of parents on how to prepare food and feed their children, and the allocation of a budget for food.

#### 7.2.4.8 Accidents

No information on agriculturally-related accidents was obtained.

#### 7.2.4.9 Pesticide Poisoning

No information on pesticide poisoning (either through occupational or accidental exposure, or intentional (suicide / murder)) was obtained. Local health facilities are not trained or equipped to diagnose pesticide poisoning.

Other observers (PAN 2006) report "Records from four health centres visited revealed serious health effects in farming communities, including death, as a result of improper pesticide storage and use." The four health centres were in Ethiopia's Rift Valley.

The Bureau of Health is very concerned about the possible health impacts of horticultural pesticides used in the rapidly expanding floriculture industry, especially for pregnant women workers and for groundwater.

## 7.2.5 Health Services and Facilities

### 7.2.5.1 Organisation

Health Centres are the focus facilities for curative and preventive health care in rural areas in Ethiopia. Each Centre is designed to meet the medical and health needs of a population of some 25,000 people. They are staffed by a Public Health Officer (4 years college training), nurses (midwives, community nurses and clinical nurses), environmental health workers and other paramedical staff. The role of the Health Centres is mainly related to public health, with some curative interventions.



Health Centres are linked downwards to (typically) five satellite Health Posts which work in conjunction with the Centre, and have a referral relationship to it for more serious and complicated treatment or needs. Each Health Post services some 5,000 persons. A Health Post is run by a Health Extension Worker (HEW) recruited locally, with basic health training. The main functions of the Health Post were described to the study team as “distribution of malarial control and contraception needs, treating and clearing malarial areas, treatment of minor ailments and referring people to the Health Centre for further treatment and vaccination programmes”. The full health extension package has 17 elements.

Generally, two Health Extension Workers are assigned to each kebele. The medical staff composition in the three woredas is given in Table 4.

**Table 7-3: Medical Staff Composition, Dembia, Fogera and Libo Kemkem Woredas, 2009**

Profession	Dembia* Woreda	Fogera Woreda	Libo Kemkem Woreda
Physician	-	0	0
Health Officer	4	4	3
Clinical Nurse (BSc)	46	1	4
Clinical Nurse (Diploma)		39	37
Nurse	3	-	-
Midwife	2	-	-
Lab technologist (BSc)	-	2	1
Lab technician	6	7	4
Environmental Health Specialist (BSc)	3	2	0
Environmental Health Specialist (Diploma)		1	3
Health assistants	7	1	1
Junior clinical nurse	-	3	0
Frontline health worker	-	1	8
Pharmacist	10	2	0
Druggist	-	5	5
Health Extension Worker	92	80	71

Sources: Dembia: RAP (SMEC 2010); Fogera and Libo Kemkem: Woreda Health Offices

The health services benefit from a significant level of external support. For example, in Dembia Woreda:

- The People Living With HIV and AIDS (PLWHA) programme is supported by World Vision through its HIV and AIDS Prevention and Control Project.
- The HIV/AIDS Prevention and Control Programme based in Kola Diba Health Centre is supported by USAID as part of the Management Science for Health project.
- Dembia Woreda is one of the target woredas of the JICA-sponsored Amhara Regional Infectious Disease and Surveillance Project.

### 7.2.5.2 Health Facilities in the Project Areas

Health facilities in and near the two project areas are listed in Table 5.

**Table 7-4: Health Facilities in and near Project Areas**

Megech Area (Dembia Woreda)	Location	Ribb Area	Location
<b>Health Centres</b>			
Kola Diba	9 km north of command area	Wereta	Fogera Woreda, on main road, southern edge of command area
Chuahit	5.5 km northwest of command area	Kiddist Hana	Fogera Woreda, southern edge of command area
Aberjeha (under construction)	5 km west of command area	Addis Betekristian	Fogera Woreda, 6 km east of command area
Gorgora	4 km south of command area	Yifag	Libo Kemkem Woreda, 4 km north of command area
Robit	4 km east of command area		
<b>Health Posts</b>			
Guramba Bata	2.5 km north of command area	Nabega	Fogera Woreda, western edge of command area
Achera Mariam	Inside command area	Shumana	Libo Kemkem Woreda, within command area
Seraba Dabelo	Within PCA	Bambiko	Libo Kemkem Woreda, within command area
Chenker Cherkose	West of command area	Bura	Libo Kemkem Woreda, within command area

Source: Dembia, Fogera and Libo Kemkem Woreda Health Offices

Note: there is a hospital in Gonder town, some 54 km from the Megech command area; similarly, the nearest hospital to the Ribb area is in Bahir Dar, some 60 km away. Gonder Hospital provides some emergency services to nearby villages, but there is no ambulance service in Dembia Woreda.

A given health institution does not strictly serve a defined catchment population. Thus residents along the Ribb River can use the Health Centres of Woreta town, Kiddist Hana and Addis Betekristian in Fogera Woreda, or Yifag on the right bank, in Libo Kemkem Woreda; they may also travel to the Health Centre in Addis Zemen. At Megech, they can use the Health Centres of Kola Diba and Chuahit, and (when it is completed) the Centre in Aberjeha (Figs. 8, 9).

**DISTRIBUTION OF HEALTH FACILITIES BY KEBELE IN 2000**

Kebele	Total Pop.	Haus hold	Urban/Rural	No. & H.F. TYPE	Distance from District Town	P. comm.
1 WORETA 01	5494	1220	URBAN	H.C. 01	1 KM	
2 WORETA 02	6391	1405	>>	>>	1 KM	
3 WORETA 03	6391	1405	>>	>>	1 KM	
4 WORETA 04	5494	1220	>>	>>	1 KM	
5 WORETA 05	6637	1434	RURAL	H.P. 01	5 KM	
6 ODHAR AGO	6369	1412	>>	H.P. 01	5 KM	
7 ODHAR MICHAL	6441	1419	>>	H.P. 01	8 KM	
8 ANDAMA KOKIT	5757	1278	>>	H.P. 01	8 KM	
9 ITILHAM ZAKIP	5757	1278	>>	H.P. 01	6 KM	
10 SHAGA	7373	6371	>>	H.P. 01	8 KM	
11 WOTE ARBAMBA	4704	2155	>>	H.P. 01	15 KM	
11 SUB-TOTAL	73888	15919				
12 DIBAMA SIFATERA	8454	1877	RURAL	H.C. 01	10 KM	
12 SUB-TOTAL	8454	1877				
13 SHIMA	9780	2171	RURAL	H.P. 01	10 KM	
14 MABEGA	10951	2433	>>	H.P. 01	10 KM	
15 WAGETERA	9593	2150	>>	H.P. 01	22 KM	
16 KIDIST HANA	7360	1634	>>	H.C. 01	15 KM	
16 SUB-TOTAL	37490	8368				
17 RIB GEBRETA	7447	1653	RURAL	H.P. 01	20 KM	
18 ADDIS BIKRIST	8958	1989	>>	H.C. 01	15 KM	
18 SUB-TOTAL	16405	3642				
19 ALEMBER TOWN	5264	1169	URBAN	H.C. 01	22 KM	
20 ALEMBER ZUKIA	7537	1629	RURAL	H.P. 01	19 KM	
21 CHALMA	5992	1330	>>	H.P. 01	27 KM	
22 MERTURA	5992	1330	>>	H.P. 01	27 KM	
23 WOTIMBE	8420	1869	>>	H.P. 01	35 KM	
24 ZENG	9222	2047	>>	H.P. 01	30 KM	
25 KIMTY	16830	2516	>>	H.P. 02	37 KM	
25 SUB-TOTAL	52658	11690				
26 AREIDA	7517	1669	RURAL	H.P. 01	50 KM	
27 GAZZEAN	7517	1669	>>	H.P. 01	50 KM	
28 DILEMO	6882	1528	>>	H.P. 01	42 KM	
29 GURAMBA	6882	1528	>>	H.C. 01	45	H.P. 01
29 SUB-TOTAL	28796	6393				
30 MENGUZER	6344	1408	RURAL	H.C. 01	15 KM	
31 ABAGUNE	7516	1669	>>	H.P. 01	23 KM	
32 ABAKIROSE	6504	1444	>>	H.P. 01	15 KM	
33 AGER SELAM	7909	1756	>>	H.P. 01	15 KM	
34 BEBEKES	7204	1599	>>	H.P. 01	15 KM	
34 SUB-TOTAL	35471	7876				
GRAND TOTAL	27114	5588				

Figure 7-8: List of health facilities and population served, by kebele, in Fogera Woreda



Figure 7-9: Health Post at Bura within command area in Libo Kemkem Woreda (right bank of Ribb River)

The health facilities of the two project areas are affected by various constraints. For example, an electric power supply is present in the towns of Chuahit and Kola Diba (Megech area), but not in Addis Betekristian (Ribb area). However the two major difficulties and limitations for health care and prevention are in access, both physical and economic:

- **Physical access:** physical access to health facilities is essential, both for patients and for health workers, especially supervisory staff. In both command areas there are serious access constraints, from the main paved road to the villages and hamlets, and from these settlements to the Health Centres and Health Posts. The earth tracks are impassable by vehicle during the wet season and at the beginning of the dry season. They are used with difficulty during the other months of the year. Walking is the most frequent way of travelling. The distance between the settlements in the core of the future irrigated areas and the Health Centres, located at the periphery and at slightly higher elevations, are around 8 to 10 km, i.e. one and a half to two hours' walking. Only 17% of respondents in the household surveys reported using vehicles to reach health facilities<sup>10</sup>. Most people walk, or are carried. Under these conditions patients suffer and it is not easy to organise efficient supervision of health workers or to send health professionals to work in the field.
- **Economic access:** economic access to health care is important for raising health standards. Household incomes are very low. The Health Centres do not charge consultation fees, but the drugs prescribed are sold on a cost-recovery basis (except for ACT for *falciparum* malaria) and the Centres can retain and utilise the revenue. Moreover, not all prescribed drugs are available or can be obtained through the national essential drug programme operated at the health centres. Besides the government health facilities, private for-profit clinics and pharmacies participate in the provision of health services. The degree to which these supplement public sector services could not be determined in the time available for the mission, but private sector participation in public health programmes in rural Ethiopia is not central to national strategies on health management. Despite the national policy of free access to health services, money remains a significant barrier to health care for the population of the project areas.

### 7.2.5.3 Traditional Healers and Medicinal Plants

There is anecdotal evidence of widespread use of medicinal plants in the area around Lake Tana. In the Dembia project area residents use a species of mint known as *damakasse* to relieve chest ailments (coughing, pneumonia). Infusions of white and blue eucalyptus (*Nej Baharzaf*) are used in the same way. Other plants are used to reduce suffering from, for example, haemorrhoids. As a prevention against bilharzia (schistosomiasis), women taking clothes to wash in rivers crush the fruits of a liana called *endod* to repel the snails and schistosomes in the water.

The Bureau of Health in Bahir Dar is concerned at the high level of harmful practices used by traditional healers.

## 7.3 PRELIMINARY IMPACT ASSESSMENT

### 7.3.1 Overview

The two irrigation projects have the goal of developing family farms and transitioning them from subsistence and food security concerns to intensified production, cash cropping and market-oriented farming. They will be implemented in two flat areas of heavy clay soils. Land use appears already at its maximum - the command areas are fully cultivated and do not show evidence of fallow land. More intense and consistent production will be obtained through the reliable regular availability of irrigation water and two or more harvests each year. The projects will not transform dry or wild environments into wet, cultivated areas, instead they will affect land which is already cultivated and flooded for a large part of the year. Consequently:

No major ecological changes are expected that would significantly change the pressure of environmental pathogens (but see Sections on malaria, schistosomiasis and intestinal helminths below)

<sup>10</sup> The data table on transport to health facilities is identical in both the Megech and Ribb feasibility studies.

Construction of the irrigation schemes will be largely mechanised, with relatively low numbers of workers. For example, at present the Ribb Dam construction site accommodates less than 100 workers. During operation, neither irrigation scheme will result in an influx of people to the command areas - these already have very high population densities. All these factors are decisive for the evolution of human health. Therefore:

- **No major health effects are expected as a result of in-migration during either construction or operation of the two schemes** (but see Sections on STIs and HIV/AIDS during construction, and urinary schistosomiasis during operation, below).

The population affected by health risks associated with the project and other changes in health conditions, including improvements, will be (i) construction workers and those local residents directly affected by construction, and (ii) all local residents in the command areas ("project beneficiaries"). Within these broad categories particular groups are at risk from or will be affected by particular health issues. For example, during land reorganisation widows and members of female-headed households will be most at risk from stress due to their marginal social position and therefore fear of losing control of land resources; during construction unskilled workers will be most at risk from occupational health and safety hazards, together with local children; during project operation farmers and other field workers will be most at risk from pesticides; diseases such as malaria, schistosomiasis and trachoma will continue to affect the entire local population. Project health benefits will also vary, in accordance with the economic improvements achieved by each family. Therefore:

- **The increased health risks due to the project are limited, but the existing high level of health hazards and associated morbidity indicate that health interventions are essential to ensure that the project's economic and social objectives are reached.**

Foreseeable changes in disease patterns associated with project implementation are noted in the following sections, by project phase - firstly Construction, secondly Operation. Health impact issues are summarised in Table 7-5, which presents the issues according to a standard categorisation of environmental health areas.

**Table 7-5: Summary of Foreseeable Health Impact Issues associated with Project Construction and Operation**

Environmental Health Area	HEALTH IMPACT ISSUES						
	Population Influx (camp followers, job-seekers)	Resettlement, Relocation	Water Management	Linear Features (roads, canals, drains)	Hazardous Materials Control and Disposal	Changes in Income & Expenditure	Infrastructure Facilities
Vector-related Diseases		X	X	X	X		
Respiratory & Housing							
Veterinary Medicine; Zoonoses					+		
STDs, HIV/AIDS	+					X	
Soil, Water & Sanitation			X	X			
Food & Nutrition		+			+	+	
Accidents & Injuries			X	X	X		
Hazardous Material Exposure			X		X	+	
Social Determinants of Health; Psychosocial; Gender Issues	+	X				X	X
Cultural Health Practices		+			+	X	X
Health Service Infrastructure & Capacity	X	X			+		X
Non-communicable Diseases					+		

X **High Potential**      Risk      + **Medium Potential**      Risk        **Low Risk Potential**

Source of matrix: p22 of IFC (2009): *Introduction to Health Impact Assessment*. Int. Finance Corporation, Washington, DC.

## 7.3.2 Predicted Health Impacts during Construction

### 7.3.2.1 Health and Safety Issues

Standards of occupational health and safety on normal construction projects in Ethiopia tend to be low and well below best international standards. Even on large projects, the risks are high: for example, some 30 deaths have been reported in the Ethiopian media from construction of Gilgel-Gibe II, a large hydropower project with extensive difficult tunnelling<sup>11</sup>.

Typically, construction injuries result from unsafe working practices, often associated with lack of training, attitudinal issues, and old or faulty equipment. Related factors are (i) the availability and use of personal protective equipment (PPE), and (ii) emergency procedures, including the provision of first aid and rapid casualty evacuation to adequate hospital facilities.

During construction, occupational health issues may arise from exposure to excessive and harmful noise, dust, vibration and toxic substances (e.g. solvents). Health and safety issues also occur at quarries and borrow pits as well as the construction sites themselves, and at camps, and during processes such as working on and over water.

Disease issues may arise during construction as a result of environmental modification (e.g. undrained pools of water becoming breeding sites for disease vectors such as mosquitoes), from worker interaction (e.g. TB transmission) and through improper food safety or hygiene practices.

In addition to work on-site, a major contributor to construction-related accidents is construction traffic; this may affect both construction workers and the public. Construction traffic may include senior staff in modern 4WD vehicles driven at excessive speeds, workers in the back of pick-up trucks liable to severe injury in the case of collisions or roll-overs, and heavy vehicles (trucks), often paid per load and therefore with an incentive to drive fast. Further risks arise due to the lack of vehicle and speed awareness of the resident population, especially small children and large livestock (cattle and donkeys).

- **Unless health and safety issues are prioritised, it is highly likely that construction of the two projects will result in avoidable injuries and health impacts.**

### 7.3.2.2 STIs including HIV/AIDS

Sexually transmitted infections and HIV/AIDS are obviously not linked to the environment but to human behaviour. Social changes can favour the transmission of these pathogens.

All around the world, including in Africa, large infrastructure projects are closely associated with risky behaviour due to the combination of single men with cash away from home, and a very poor local population in which women have low educational levels and status. Construction of the two irrigation projects (as well as the Ribb and Megech Dams) will require a significant number of workers from outside the immediate area, even though much of the earthwork activity is mechanised. Some of the workers will live in purpose-built staff accommodation (camps), with unskilled workers typically drawn from the locality and returning home at night. It is inevitable that this temporary influx of paid male labour (including higher levels of staff) will encourage prostitution.

- **Considering the consequences of STIs, especially HIV/AIDS, this is a highly significant potential impact, requiring appropriate mitigation during the construction phase.**

<sup>11</sup> Muluken Yewondwossen. 2009. Gibe II completed for 373 million Euros and 30 lives. Article in *Capital*, Vol. 11 No. 543, Sunday, May 10 2009.

### 7.3.3 Predicted Health Impacts during Operation

#### 7.3.3.1 Malaria

Improved land drainage and a reduction in flooding brought about by flood protection works will probably reduce but not interrupt the production of *Anopheles* at the end of the wet season and at the beginning of the dry season. This will reduce the malaria attack peak at this time of the year. Instead, **the malaria transmission pattern is likely to change, with attacks throughout the year at a low but permanent level.** This pattern would not be an improvement of the situation, but also not a significant worsening. Note that in the Fogera plain the recent development of informal dry-season irrigation may have started to change malaria patterns.

With respect to the lethality of the disease (deaths amongst those infected), endemic malaria is less dangerous than short, intense seasonal transmission. However:

- **With respect to morbidity (non-lethal health impacts), permanent (year-round) malaria has a very high impact on human health, especially for children.**

The predicted situation could be changed by if extensive prevention measures (use of bednets) and treatment (fast access to diagnosis and efficient drugs) are implemented.

#### 7.3.3.2 Intestinal Schistosomiasis

The increase in contact between humans and still or stagnant water will probably lead to a more intense transmission of *S. mansoni*. These contacts will be most frequent at the level of the tertiary canals and during the distribution of water onto plots. The new, permanent water bodies (canals and drains) may be favourable snail habitat and create a snail outbreak; if the snails are infected with *Schistosoma*, transmission could increase significantly. The parasites are already present in both command areas. Consequently:

- **Increased transmission of intestinal schistosomiasis is the most important risk to public health during project operation.**

Risk reduction can be achieved by breaking the parasites' lifecycle at the stage from human beings to snails, but this would require major behavioural changes throughout the local population.

#### 7.3.3.3 Urinary Schistosomiasis

At present, urinary schistosomiasis is not reported in the proposed irrigation areas. Despite *Bulinus* snails being present in some ponds or puddles, the particular strain of snails and maybe also the environmental conditions do not allow the development of *S. haematobium*. However, changes in the environment, particularly the presence of slow running water during the warm and dry season, could lead to the appearance of new strains of *Bulinus* receptive to *S. haematobium*. Thus:

- **The outbreak of urinary schistosomiasis in the population living and/or working in the command areas is unlikely but possible.**

#### 7.3.3.4 Soil-related Intestinal Helminths

Soil-related helminth larvae use wet soils and plants for an obligatory part of their lifecycle. The presence of permanently moist soils year-round and farming activities in the irrigated plots will increase the probability of human infection by hookworms through the skin of feet and legs. The transmission of *Ascaris* and other helminths will increase if contaminated vegetables are eaten without cooking (for example, raw vegetable such as salads or tomatoes), but at present these are not traditional foods. In summary:

- **Risks of infection by soil-related intestinal helminths will increase as a result project implementation.**

As with the two forms of schistosomiasis, a sustainable reduction of transmission can be achieved by interruption of the parasites' lifecycle at the stage from human beings to the external environment.

### 7.3.3.5 Visceral Leishmaniasis

The sandfly vector is present around both command areas in dry, rocky habitats with bushes. It does not favour wet, cultivated farmland, so:

- **Operation of the two irrigation projects should not lead to an increase of numbers of the vector or in *Leishmania* transmission.**

VL is likely to continue with its existing pattern, including the endemic situation in the Ribb PCA. Improvements in the health status of individuals will reduce their susceptibility to the disease. There is concern that VL will continue to be introduced to the area by migrant workers returning from lower elevations in Ethiopia.

### 7.3.3.6 Dracunculiasis

Irrigated areas are not favourable places for dracunculiasis transmission. Copepods are present but not the other elements of the parasite's lifecycle; human beings are not carriers of the parasites, and usually humans do not usually use irrigation water as drinking water. However, the future situation with respect to drinking water in the command area is unclear.

- **An increase in risk of dracunculiasis is unlikely.**

### 7.3.3.7 Other Vector-borne Diseases

**Yellow fever and Dengue:** mosquitoes of the genus *Aedes*, the vectors of yellow fever and dengue virus, do not use canals or puddles as breeding places. The larvae need small natural or man-made containers of clean water for their development. The irrigation schemes could lead to an outbreak of these diseases only if places for the larvae - for example, abandoned tyres or empty cans - are present. At present the very low level of money income of the peasants and consequently their low consumption of manufactured products does not favour such waste close to homesteads since such resources are re-used or recycled rather than dumped.

- **The increased use of containers associated with increased incomes may increase the risk of both these diseases.**

**Human African Trypanosomiasis:** the sleeping sickness vectors, tsetse flies, are not present on the Ethiopian plateau (biting flies, mostly of the genus *Stomoxys*, are present everywhere in the command areas but are only vectors for bovine trypanosomiasis, not the human form of the disease). The local changes in the environment of the command areas caused by irrigation and drainage will not create favourable habitat for the reproduction of these flies, which need crumbly soils, high and dense vegetation, and high temperatures.

- **The project will not result in the introduction or spread of sleeping sickness.**

**Onchocerciasis:** this disease is not reported from the Ethiopian plateau despite many natural streams with fast-running water. The blackfly vectors are not present. The slowly flowing water in the irrigation canals will not be favourable habitat for the larvae. The water in the Ribb (and Megech) reservoir is also unlikely to be a favourable habitat due to slow flow conditions, low temperatures and lack of organic constituents. The probability of blackflies swarming is near zero.

- **The project is unlikely to cause any increase in the risk of onchocerciasis.**

### 7.3.3.8 Waterborne Diseases

**Diarrhoeas:** at present these are frequently observed in the poor rural population living in the command areas. Irrigation of fresh produce with water contaminated by *Escherichia coli* bacteria could cause illness if the vegetables are not washed in clean water or cooked before consumption.

- **The presence of more water during a longer period of the year as a result of irrigation is unlikely to cause any change in the incidence of diarrhoeas.**
- **Contamination of fresh produce with pathogens such as *E. coli* is possible if the irrigation water is contaminated before use.**



The incidence will only increase or decrease as a result of changes in the general level of sanitation, especially access to safe water for drinking and cooking, personal hygiene, the management of faeces and the storage and preparation of food.

**Poliomyelitis:** this is present in some parts of Ethiopia but at a very low level. Control of the disease is carried out by mass vaccination. The Ethiopian public health system is effective in undertaking large, repeated vaccination campaigns.

- **Because there is no relation between the rate of transmission of poliomyelitis and the quantity of water in farmland, there should be no change in poliomyelitis as a result of the project.**

**Hepatitis A:** as with polio, this disease is not related to the quantity of water in the environment. Its incidence will decrease only with large and repeated mass campaigns of vaccination, together with better domestic water supplies, sanitation practices, hygiene and food preparation.

- **The project, by itself, should not change the incidence of hepatitis A in the local population.**

### 7.3.3.9 Other Diseases and Health Problems

**Trachoma:** this results from *Chlamydia* transmission by flies and dirty hands; its incidence will not be directly altered by operation of the irrigation and drainage schemes. The incidence of trachoma will decrease if contacts between human beings and flies are reduced, and if general hygiene standards improve, including use of latrines. The use of stables for livestock could contribute to fly reduction, but it is not realistic to expect this under the conditions of the project areas. However, the projects are likely to alter livestock husbandry practices and numbers through reducing the area available for grazing and fodder production, and by mechanisation. Over the longer term this might contribute towards reduced fly numbers, but:

- **No early reductions in trachoma incidence should be expected.**

**Acute respiratory tract infections (ARTI):** these are largely a consequence of bad housing conditions, cool temperatures, the frequent presence of smoke in houses, and the lack of warm clothes.

- **The irrigation projects will not, by themselves, reduce the incidence of ARTI.**

Reduced ARTI will only be achieved through the improved living conditions associated with higher incomes, better education, and improved health services which, hopefully, will result from the projects.

**Pulmonary tuberculosis:** the same environmental conditions that favour ARTI (poor housing, cool temperatures, smoke, inadequate clothing), as well as overcrowding, poverty, human behaviour, and also the presence of AIDS, favour the transmission of pulmonary tuberculosis. The prevention of new cases of TB requires fast diagnosis and efficient treatment, both of the sick persons and of asymptomatic carriers of the tuberculosis bacteria.

- **The project, by itself, will not change the incidence of TB.**

Reduced TB will only be achieved through the improved living conditions associated with higher incomes, better education, and improved health services which, hopefully, will result from the projects.

**STIs and HIV/AIDS:** as noted under Construction (3.2.1 above), sexually transmitted infections and HIV/AIDS are not linked to the environment but to human behaviour. The consequences of operation of the two schemes for sexual behaviour of the population are hard to predict. However, improved general education and specific awareness of STI and HIV/AIDS prevention techniques can both be expected to improve, in line with a general increase in living standards. A particular hazard will result from the increased economic activity generated by the schemes, specifically the growth of market centres on main roads with their associated bars and prostitution.

- **Of particular importance for sexual disease prevention is the degree to which women are empowered by the two development projects.**

**Zoonoses:** the project is intended to improve standards of livestock husbandry including animal health. Therefore:

- **The incidence of some zoonoses is expected to decline, in line with improvements in standards of animal health and general hygiene.**

**Malnutrition:**

In some irrigation projects elsewhere in Africa an increase of chronic or acute malnutrition of infants, children or adolescents has been observed after starting irrigated cropping (Brun 1991; Mwadime *et al.* 1996). This is due to the wish to maximise incomes through growing and selling cash crops and giving up traditional crops, and also to difficulties in the management of farm budgets, and un-manageable increases in labour demands. Overall:

- **Malnutrition should decrease with an increase in food production and an improvement in family incomes, food security and education, especially of mothers.**

**Accidents:** the projects will increase road traffic and agricultural mechanisation (at present both are at zero). Consequently:

- **Accidents associated with vehicles and agricultural machinery can be expected.**

**Pesticide poisoning:** the projects will intensify agricultural production, a process typically associated with increased use of pesticides (insecticides, herbicides and fungicides, as well as other categories such as rodenticides). Many of these chemicals are toxic to humans as well as to the target and non-target species. The system for controlling pesticide use in Ethiopia is weak (see Pest Management Plan, a separate report prepared for the ESIA). Consequently:

- **The risks to human health of pesticide use during project operation are high.**

Exposure could be through a number of different routes, especially occupational (during handling, mixing and application), accidental (from contaminated clothes, re-use of containers etc.), and through consumption of residues on food crops.

## 7.4 MITIGATION MEASURES AND MONITORING

### 7.4.1 Introduction

This chapter presents an outline of mitigation measures proposed for the Megech and Ribb projects, based on knowledge obtained from a review of the health literature, from the fieldwork carried out in October 2009 and from follow-up in 2010. The proposals are at a level of detail consistent with standard health impact assessment methodologies which describe a phased, iterative approach to the identification and management of health hazards and risks.

Mitigation of some health risks can be achieved (i) by **prevention**, through design changes, changes in operation practices to alter environmental parameters such as groundwater levels, or changes in human behaviour, thereby preventing disease transmission, or (ii) by **treatment**, curing infected patients and, for communicable diseases, reducing transmission frequency.

Outbreaks of disease can appear rapidly. On the other hand, changes in knowledge, attitudes and behaviour are slow, but they are essential to achieve sustainable improvements in human health. Therefore:

- **Sustained improvements in health will only be achieved by major changes in health-related knowledge, attitude and practices (KAP) by local residents.**

Worldwide, achieving changes in KAP is very difficult, especially in rural areas with a very poor and uneducated population. Therefore, for the two projects:

- **Sustained health improvements will need:**
  - (i) **long-term investment in social services (education, health) with special attention to women's issues;**
  - (ii) **improvements in both community infrastructure (roads, electricity) and domestic infrastructure (housing, water supply, sanitation);**
  - (iii) **higher incomes.**

Mitigation measures must be practical; this means economically realistic, culturally acceptable (not clashing with traditional practices and belief)<sup>12</sup>, and implementable without excessive work. Typically they focus on (a) disease prevention (following the hierarchy of (i) prevention by avoidance (changed project design, bed nets, etc), (ii) clinical prevention for populations at risk (hand washing, use of condoms, etc), and only then (iii) curative services), and (b) health promotion and education.

Proposed mitigation measures for the two projects are summarised in Table 7-6 and described in the following text by project phase, firstly Construction, then Operation.

The final three sections of this chapter concern Monitoring and Evaluation, Health Organisation and Strengthening, and Costs and Financing.

**Table 7-6: Proposed Health Mitigation Measures, by Priority**

Health Impact	Mitigation Measure	Responsibility
<b>Construction Phase</b>		
1. Health and Safety - hazards to workers and public	• Upgrade tender documents with respect to H&S	Design consultant & ESIA consultant
	• Make some H&S requirements pay items, to provide an incentive for compliance	Design consultant, MoWR
	• Task the supervision consultant, explicitly, with H&S enforcement and provide resources for this	MoWR
2. STIs and HIV/AIDS - risk of increased transmission	• Construction worker health checks, awareness and prevention programmes	Contractors
	• Local resident awareness and prevention campaigns, especially for at-risk groups	MoH / BoH, local health units, staff of specialised health programmes
<b>Operation Phase</b>		
1. Malaria - change in pattern	• Mass bednet programme	BoH / Woreda Health Offices
	• Health worker training & supervision	BoH / Woreda Health Offices
	• Water management	Project operator / WUAs
2. Schistosomiasis - risk of increased transmission	• Repeated mass treatment	BoH / Woreda Health Offices
3. Intestinal Helminths - risk of increased transmission	• Repeated mass treatment	BoH / Woreda Health Offices
4. STIs & HIV/AIDS - possible increased transmission	• Targetted awareness and education campaigns, condoms	BoH / Woreda Health Offices
	• Improving STI diagnosis and treatment capability of health workers	BoH / Woreda Health Offices
	• Assist local administrations to advocate for better STI & HIV/AIDS programming	MoWR
5. Diarrhoeas - continued transmission	• Intensified health education	BoH / Woreda Health Offices
	• Provision of safe domestic water supplies (requires feasibility study prior to design and implementation)*	Woreda Water Supply Offices
	• Identification & promotion of appropriate latrine technology	BoH / Woreda Health Offices, with technical assistance
6. Trachoma - continued transmission	• Intensified health education	BoH / Woreda Health Offices
7. Acute respiratory tract infections - continued transmission	• Promotion of indoor-smoke reduction technologies	BoH / Woreda Health Offices
	• Improving ARTI diagnosis and treatment capability of health workers	BoH / Woreda Health Offices
	• Ensuring availability of drugs at affordable prices	MoH / BoH

<sup>12</sup> Of course, some issues are "non-negotiable", such as eradicating female genital mutilation. Woreda-level Women's Affairs Offices are active in promoting change relating to "Harmful Traditional Practices" such as early marriage.

Health Impact	Mitigation Measure	Responsibility
	<ul style="list-style-type: none"> <li>Improving physical access to health facilities (all-weather paths and roads)</li> </ul>	Woreda ARD Offices
	<ul style="list-style-type: none"> <li>Adult education concerning use of increased incomes for household betterment</li> </ul>	Woreda Education Offices
8. <i>Malnutrition</i> - continued risk	<ul style="list-style-type: none"> <li>Female literacy programmes*</li> </ul>	Regional & Woreda Women's Affairs Offices
	<ul style="list-style-type: none"> <li>Inclusion of nutrition in other health education packages</li> </ul>	BoH / Woreda Health Offices
	<ul style="list-style-type: none"> <li>Promotion of homestead gardens and livestock micro-enterprises to improve household food supplies</li> </ul>	BoARD / Woreda ARD Offices
* Note: asterisked items are the highest gender-related priorities		

Source: Consultant

## 7.4.2 Construction Phase

### 7.4.2.1 Health and Safety

Construction of the two projects will be tendered internationally by MoWR using standard World Bank international competitive bidding (ICB) procedures. The WB's standard bidding documents have limited emphasis on Health and Safety (H&S) and will need significant adjustment (i) to adapt them to the specifics of the two irrigation projects, and (ii) to give H&S the priority which is needed to ensure that reasonable standards are actually implemented on site. Recommendations:

- Project-specific H&S provisions should appear in both the General Conditions and in the Specifications, according to topic. Note: it is important that all areas and processes affected by construction activities are covered by the definition of "the Site" in the contract documents.**
- It is strongly recommended that some H&S requirements are inserted as items in the Bill of Quantities, so that the successful bidder has a financial incentive for good performance (a carrot) as well as the stick of compliance and enforcement.**
- The supervision consultant should be explicitly tasked with and resourced for enforcement of the H&S provisions in the construction contracts.**

Notes:

(i) Proposals for H&S provisions will be included in the Environmental and Social Management Plan (ESMP) forming part of the ESIA report for each of the two schemes. See also Annex 10 of this Volume "Recommendations for Tender Documents".

(ii) Some measures to mitigate potential health impacts during construction and operation are "standard best practice" and therefore not highlighted here. These include, for example, keeping the site well drained, restoring borrow pits and quarries to avoid the creation of pools of standing water, proper disposal of solid and liquid wastes, high standards of food safety in any canteens, enforcement of good standards of hygiene amongst workers on site, etc.

### 7.4.2.2 STIs and HIV/AIDS

As stated in the 2004-2008 Ethiopian Strategic Plan for Intensifying Multisector HIV/AIDS Response (MoH 2004), "... without urgent attention and effective intervention, a potentially devastating epidemic is a threat to rural areas, where the majority of Ethiopians live (>85%) and upon which the economy of the country heavily relies." For this reason, as well as its intrinsic health benefits:

- It is important that the construction process be accompanied by STI and HIV/AIDS awareness and prevention measures.**

**Recommendations:** the details of these measures and their delivery will need to be worked out in consultation with the stakeholders (MoH, Regional Bureau of Health, local health offices (WorHOs), and MoWE), but the basics would include:

- **Examination and treatment of all workers upon recruitment.**
- **Awareness programmes for workers.**
- **Easy access to prophylactics (condoms) for workers.**
- **Similar programmes of information, education and communication (IEC) targeted to vulnerable groups in the local population, specifically single women, existing prostitutes, bar owners, and truck drivers.**

Delivery mechanisms will include (i) the construction contractors, through their medical services; (ii) MoH / BoH through their specialised staff; (iii) local health workers (health extension agents), and (iv) staff of any specialised project or NGO appropriate to the topic.

Note that the Terms of Reference for the Resettlement Action Plan (RAP) also specifically cover the topic of HIV/AIDS during construction.

## 7.4.3 Operation Phase

### 7.4.3.1 Introduction

This section describes specific responses for various health hazards intensified by the project or unlikely to be reduced by the project without specific measures. In considering these recommendations, it must be emphasized that **the three most important health interventions, in the long term, are likely to be:**

- **Roads** (roads are essential not only for development of the agricultural aspects of the schemes, but also for the organisation of health services, for training health workers, and for supplying drugs and vaccines).
- **Safe domestic water supplies**
- **Female literacy**

### 7.4.3.2 Malaria

**Spraying:** reduction of the *Anopheles* population by repeated house spraying with residual insecticides is not realistic. Nowhere in tropical areas has a long-term result been obtained by this method. This is due to (i) changes in mosquito behaviour and in insecticide effectiveness (Biscoe *et al.* 2004), (ii) the cost of such activities, and (iii) the need to repeat the spraying one or two times every year in all houses for many years.

**Bednets:** reduction of contacts between humans and *Anopheles* by the use of impregnated bednets is useful. This has been proved to result in a reduction of the incidence of the disease. Together with efficient health facilities and health education, the general result of mass use of bednets, preferably impregnated with a long lasting insecticide, is a dramatic decrease in malaria morbidity and mortality.

Long lasting impregnated nets (LLINS) were widely distributed in Amhara State some years ago. However, the bednets are fragile and do not last more than two or three years. Consequently, at present they are not available for each individual in all households. Moreover, they are not easy to use in houses without beds, and not all the residents are convinced of their effectiveness against malaria.

**Habitat management:** it may be possible to reduce vector numbers by managing the water in the canals and reservoirs and/or the introduction of fish (but only those indigenous to the Lake Tan sub-basin).

The irrigation projects will not worsen the malaria situation because malaria is already present in the area with effects on individuals of all ages. On the contrary, the projects could contribute to significant long term improvements if they result in an increase in (i) the effectiveness of local health facilities, and (ii) raise household incomes. However, reducing malaria morbidity and mortality in the region is a battle to be fought every day for a very long time.

One immediate requirement to reduce the malaria burden is an intense education campaign. At the same time, the Health Centres and Posts have to be more efficient in diagnosis of fever attacks and malaria treatment. Likewise, supervision of health workers by an experienced, specialised medical doctor would be of great value. This supervisor should be able to visit every health facility and to use his/her time for staff training, not for any bureaucratic supervisory process.

**Recommendations:** in relation to the probable change in malaria incidence patterns caused by the projects, four specific actions are recommended:

Firstly, increased coverage and use of bednets (target - 100% of population) by a large and repeated distribution of LLINs, together with (i) training of the population in their use, (ii) monitoring of the results, and (iii) increased awareness of the importance of rapid, accurate diagnosis and treatment. This action has to be developed with strong involvement of the responsible health workers.

Secondly, "hands-on" supervision and training (practical "professional development") of local health workers by a physician specialised in malaria, its clinical and biological diagnosis, its treatment, and its management in rural areas.

Thirdly, management of the irrigation system's water distribution and drainage networks to avoid stagnant water (flows should be > 0.1 m/s) and removal of emergent vegetation.

- **Fourthly, establishment of a monitoring programme for this important disease, commencing before project commissioning (see Section 7.4.4).**

#### 7.4.3.3 Intestinal and Urinary Schistosomiasis, Intestinal Helminths

Environmental management: reduction of snail populations by activities such as drying out and cleaning canals as done on the Wonji scheme in the Awash Valley may not be feasible on these two projects because the soils are cracking clays, and if the canals are dried out they may develop unacceptable seepage problems. The snails will be present in the tertiary canals and drains and it is extremely difficult to be effective in channel sanitation at this level: draining the channels and cleaning all the aquatic vegetation have to be done every two months; this is an excessive work load for farmers.

Latrines: coercive measures to make the population use latrines are not effective. Without any obvious personal advantage, individuals will prefer to relieve themselves quietly behind a bush, in the fields and near water. Only general education and social change can alter this, over the long term. Construction and use of appropriate latrines is an important long-term goal.

**Recommendations:** in relation to the probable increase in schistosomiasis transmission and helminth infections, three specific actions are recommended:

- **Firstly, repeated mass treatment of local residents against adult *Schistosoma* worms, using a drug such as praziquantel.** The aim would be to treat all the population every six or twelve months. This treatment is cheap, well accepted because it is free of side effects, and effective. With repeated mass treatments the incidence of new *S. mansoni* infections does not decrease, but heavy infections disappear. Each individual tends to be infected with a fewer and fewer parasites and will have reduced or no clinical symptoms, a major benefit, and will have many fewer parasites to pass on. Urinary schistosomiasis is also treated by praziquantel.
- **Secondly, repeated mass treatment of local residents by drugs such as pyrantel or albendazole to cure intestinal worm infections.** These drugs are effective, cheap, and well accepted. Repeated mass treatments do not stop the transmission of soil-related helminths, but heavy infections with important consequences for health will become absent or rare in the treated population.
- **Thirdly, establishment of a monitoring programme for these important diseases starting before project commissioning (see Section 7.4.4).**

#### 7.4.3.4 Diarrhoeas

**Recommendations:** the incidence of diarrhoeas in the beneficiary population in the two command areas will not decrease without specific actions. In addition to improved general education, and assuming continued curative care of severe cases by health workers, these are:

- **Firstly, intensified health education (especially hygiene) for disease prevention, as well as home treatment.**

- **Secondly, supply of safe water for domestic consumption.** This is critical, since water from surface sources and from shallow groundwater is generally not safe. Piped supplies could be provided from safe or treated sources upstream, but this would be extremely expensive. Deep drilling and pumping is also expensive, and may be ruled out by salinity. The only realistic options appear to be use of shallow groundwater or surface water, but in both cases treatment (disinfection) is essential. This subject requires additional study to develop practical, cost-effective and sustainable solutions prior to design and roll-out across the command areas. Whatever systems are adopted, they should be managed locally and involve a fee, however nominal, to ensure local ownership.
- **Thirdly, identification and then promotion of appropriate latrine systems.** This will require experimentation with different latrine technologies to identify low-cost culturally-acceptable systems capable of effective operation in the high-groundwater command areas (i.e. some type of compost toilet).

#### 7.4.3.5 Trachoma

The incidence of trachoma in the command areas will decrease if general hygiene improves, if the swarms of flies are reduced, and with effective treatment of cases.

**Recommendations:** considering the lack of any realistic prospect of reducing fly numbers, the following action against trachoma could be taken in the command area:

- **Awareness and prevention activities by health workers, especially in locations far away from health facilities, through an extension of the SAFE programme.**

Treatment of eye lesions is a task for Health Posts and Centres and, after education, for families. Serious lesions can only be treated by a specialised team.

#### 7.4.3.6 Acute Respiratory Tract Infections

Acute respiratory illnesses are difficult to prevent. They will probably persist at the same level for many years.

**Recommendations:** actions that will assist in reducing ARTIs and that could be taken as part of a health programme associated with the two projects include:

- **Reduction of indoor smoke** by promoting household ventilation, smokeless stoves, solar cookers and gas, biogas or kerosene stoves.
- **Improving the ARTI diagnosis and treatment capability of health workers.**
- **Improving the availability and quality of drugs, especially antibiotics, in health facilities or other sales outlets, at a price compatible with local income levels.**
- **Improving physical access to health facilities.** This is very important, both for users (e.g. pregnant women, elders) and for health workers, as well as for medical supervisory staff. At present access is good to facilities near paved roads on the edge of the command areas, but very difficult to facilities inside the schemes because the lack of roads and all-weather tracks.
- **Promoting the use of increased household incomes resulting from the project for better clothes, shoes, bedding, and (eventually) better housing (adult education in "domestic economy").**

#### 7.4.3.7 Sexually-transmitted Diseases and AIDS

Given the link firstly between irrigation and cash availability to households, and secondly between increased cash availability and increased STI transmission, it is important to integrate appropriate responses into the projects as early as possible. Prevention of STIs and AIDS is strongly linked to behaviour and consequently to education levels. It depends also on gender relations, the balance and practice of power between men and women and between elders and young people. It is obvious that both general and health education are the best ways to prevent these diseases. Treatment of STIs is also useful to prevent infection of partners and to reduce the risk of co-infections by various pathogens.

**Recommendations:** actions to manage the STI and HIV/AIDS risks associated with the projects during operation are:

- **Firstly, design and implement awareness and education campaigns concerning STIs and AIDS.**

- **Secondly, train health workers to be more effective in the diagnosis and treatment of STIs**
- **Thirdly, consistent with the national HIV multi-sector approach, devise mechanisms to empower local administrations to develop advocacy for improved access to HIV counselling and testing, and STI prevention and care.**

Note: as part of the social interventions around the project, the issue of HIV/AIDS risk being a possible consequence of poverty reduction should be introduced, and the responsibility of local authorities in controlling it should be emphasised. Sensitisation to health and HIV issues is regarded as critical for long term sustainable project and socio-economic outcomes, and should be resourced accordingly .

- **Fourthly, establish and maintain appropriate surveys (see Section 7.4.4).**

#### 7.4.3.8 Malnutrition

The two projects have a goal of increasing household-level incomes by intensification and commercialisation of agriculture, especially crops. Malnutrition is closely tied to general income levels, as well as to the management of household budgets and the income from crop and other product sales, to mother and child health and to education. It is important for farming households to retain enough products for domestic use as well as for sale and to use these well, especially in accordance with the needs of infants and children in terms of energy and proteins. Commercialisation of agriculture should not be a reason to abandon cereal cropping or to sell all the harvest. Poultry and sheep are important for access to animal proteins.

**Recommendations:** the residents' education programmes now offered in the Health Posts are already showing signs of changing attitudes. These should be continued. To achieve the national socio-economic development objective of reducing malnutrition and avoid the low but real project-specific risk of reduced household food security due to sale of crops, the most significant actions that could be taken in the command areas would be:

- **Firstly, general education, especially female literacy, to enable residents to obtain and absorb further information.** This will progressively result in better understanding by mothers of child nutrition.
- **Secondly, integration of nutrition-related issues (household resource management and food preparation) into the health education and awareness packages recommended to accompany project implementation. Specific attention should be paid to gender issues in nutrition.**
- **Thirdly, promote homestead gardens and livestock micro-enterprises (e.g. poultry), specifically to augment and enrich household food supplies as opposed to exporting food from the command areas.**
- **Fourthly, implementation of an appropriate nutrition monitoring programme** (see Section 7.4.4).

#### 7.4.3.9 Accidents

The improved access associated with both projects will (i) improve health service provision locally (better health posts with more equipment and higher skills), and (ii) facilitate transport of patients to health facilities outside the PCAs. However, physical and economic access to emergency will remain a challenge for many local residents.

**Recommendations:** actions to reduce accidents and improve emergency care include:

- **Skills training in use of all new tools and machinery.**
- **Awareness for households (especially women, elder children) of potential dangers from agricultural equipment, traffic, and (if relevant) canal siphons and under-passes.**
- **Inclusion of a mandatory health insurance premium in the water user fee to cover at least (i) costs of travel to emergency care facilities, (ii) emergency treatment.**

#### 7.4.3.10 Pesticide Exposure

Measures to avoid pesticide exposure and manage pesticide health risks are described in the Pest Management Plan developed as part of the projects' Environmental and Social Management Plans (ESMPs).



## 7.4.4 Health Monitoring and Evaluation

### 7.4.4.1 Overview

This analysis indicates that, without mitigation, the projects have the potential to change health risks in relation to malaria, schistosomiasis (both forms), intestinal helminths, STIs and HIV/AIDS, nutrition, accidents, and pesticides. Specific measures are recommended to deal with these risks, together with recommendations to deal with continuing health hazards which are unlikely to be affected by project implementation (previous Section).

It is recommended that the following six project-related health hazards are monitored before and during project operation (Table 7-7) so that (i) the effectiveness of the mitigation measures can be determined, and (ii) early warning can be given of any significant changes in health risk, thereby allowing management action:

- Malaria
- Schistosomiasis and intestinal helminths
- STIs and HIV/AIDS
- Malnutrition
- Accidents (including health and safety incidents during construction)
- Pesticide exposure

The monitoring should be based on Key Performance Indicators (KPIs). KPIs may be Structural, Process or Outcome indicators (IFC 2009):

- **Structural indicators** measure physical features such as drugs, latrines, clinic buildings, vehicles, staff, budgets, and also household characteristics and health service delivery arrangements.
- **Process indicators** assess the effectiveness of actions such as changes in times required to access water, number of pre-delivery visits to mothers, and KAP related to diseases.
- **Outcome indicators** measure the long-term effects of health programmes, such as infection rates, child height and weight for age, number and severity of accidents.

Definition of the most useful and practical KPIs for specific purposes such as project-related health monitoring is a complex task. As far as possible indicators should match those used in national or international programmes, for example the health-based performance indicators established by the Millennium Development Goals (MDG) which include HIV and malaria rates.

For institutional sustainability, as far as possible the projects' monitoring and evaluation programmes should be integrated into the normal functions and procedures of the BoH and health offices at lower administrative levels.

**Table 7-7: Proposed Health Monitoring Measures**

Health Impact	Mitigation Measure	Monitoring / Indicators	Method	Location	Frequency / Timing	Responsibility	Cost
<b>Construction Phase</b>							
1. Health and Safety	<ul style="list-style-type: none"> <li>Higher standards on site</li> </ul>	Number of incidents, by type, in relation to workforce numbers	Contractor's reports	On site	Immediate for severe incidents, monthly for all incidents	Construction contractor, PSP contractor	Nil (contractor's overheads)
2. STIs and HIV/AIDS	<ul style="list-style-type: none"> <li>HIV/AIDS awareness and prevention programmes</li> </ul>	Awareness classes delivered; Number of participants Attitudes and behaviour HIV status in at-risk groups	Contractor's and WorHO reports KAP surveys Clinical tests	On site Woreda HQs Health Centres	Monthly reports Annual survey of at-risk groups	Construction contractor, WorHO, BoH support	TBD
<b>Operation Phase</b>							
1. Malaria - change in pattern	<ul style="list-style-type: none"> <li>Mass bednet programme</li> </ul>	Bednets issued Bednets actually used	WorHO reports Household survey	Command areas	Monthly reports Annual survey	WorHO, BoH support	TBD
	<ul style="list-style-type: none"> <li>Health worker training &amp; supervision</li> </ul>	Skills classes held Number and type of participants Equipment and materials supplied	WorHO reports	Command area kebeles	Monthly reports	WorHO, BoH support	TBD
	<ul style="list-style-type: none"> <li>Reliable monitoring</li> </ul>	Malaria incidence by location and type	Review of diagnostic and reporting systems Design of accurate and reliable system specific to the projects Provision of skills, equipment, budgets necessary for system Implementation of system	Command area and Kebeles and Woredas	Prior to construction	BoH	TBD
2. Schistosomiasis and Intestinal Helminths - risk of increased transmission	<ul style="list-style-type: none"> <li>Repeated mass treatment</li> </ul>	Prevalence	Design of reliable survey process Provision of necessary skills, equipment, budgets Survey implementation	Command area and Kebeles and Woredas	Prior to project commissioning & prior to mass treatments (every 6 - 12 mo)	BoH	Treatment: USD 0.50/pers Surveys: <USD 10,000

Health Impact	Mitigation Measure	Monitoring / Indicators	Method	Location	Frequency / Timing	Responsibility	Cost
3. STIs & HIV/AIDS - possible increased transmission	• Targetted awareness and education campaigns	Awareness classes delivered; Number of participants Attitudes and behaviour HIV status in at-risk groups	WorHO reports KAP surveys Clinical tests	Woreda HQs Health Centres Market centres	Monthly reports Annual survey of at-risk groups	WorHO, BoH support	TBD
	• Improving STI diagnosis and treatment capability of health workers	Skills classes held Number and type of participants Equipment and materials supplied	WorHO & BoH reports	Woreda, Region	Quarterly	WorHO, BoH	TBD
	• Reliable monitoring	HIV prevalence in at-risk groups	Review of diagnostic and reporting systems Design of accurate and reliable system specific to the projects Provision of skills, equipment, budgets necessary for system Implementation of system	Command areas and market centres	Prior to construction Regular clinical reporting (monthly / quarterly) Behaviour survey every 3 years	WorHO, BoH	TBD Surveys ~USD 50,000
4. Malnutrition - continued risk	• Female literacy programmes	Classes delivered Number of participants Literacy skills in target groups	Woreda education office reports Surveys	Command area kebeles	Quarterly reports Annual surveys	Woreda and regional education offices, PSP contractor	TBD
	• Inclusion of nutrition in other health education packages	Inclusion in training materials	Check materials and sample of actual package deliveries	Command area kebeles	Annual	WorHO, BoH	USD 10,000
	• Promotion of homestead gardens and livestock micro-enterprises to improve household food supplies	Household production and incomes	Household surveys	Command area	6 monthly	"The Project", PSP contractor	4/yr
	• Reliable reporting	Nutritional status of 2 - 9 year olds in command areas	Surveys: design reliable survey, provide skills, equipment and budgets, implement	Command area kebeles: beneficiary households	Prior to scheme commissioning Every 2 years	WorHO, BoH	TBD

Health Impact	Mitigation Measure	Monitoring / Indicators	Method	Location	Frequency / Timing	Responsibility	Cost
5. Accidents	• Skills training for farmers	Classes delivered Number of participants	ARD office reports	Command area Kebeles	Monthly	ARD offices, PSP contractor	TBD
	• Awareness training for households	Classes delivered Number of participants Change in KAP	ARD and DA reports	Command area households	Monthly	ARD offices and DAs, PSP contractor	TBD
	• Inclusion of health insurance in WUA fee	WUA bylaws and practice	Inspection	Command areas	Annual	ARD / BoH / PSP contractor	Nil
	• Reliable reporting	Number and type of accidents	Regular health facility reports	Command area Kebeles and Woredas	Monthly / quarterly	WorHO, BoH	Nil
6. Pesticide exposure	• Skills training for farmers and other workers	Classes delivered Number of participants Change in KAP	ARD office reports	Beneficiary farmers and contract sprayers	Monthly	ARD offices, PSP contractor	TBD
	• Awareness training for households	Classes delivered Number of participants KAP	ARD and DA reports	Command area households	Monthly	ARD offices and DAs, PSP contractor	TBD
	• Create pesticide exposure diagnosis and treatment capacity at regional level	Specialised unit operational Skilled staff	BoH reports	Bahir Dar	Semi-annual	BoH	TBD
	• Reliable reporting	Number and type of pesticide exposure cases	WorHO, BoH reports from specialised unit	Woredas, Bahir Dar	Regular reporting	WorHOs, BoH	TBD

#### 7.4.4.2 Malaria

The projects are likely to change the pattern of malaria transmission throughout the year within the command areas. Mitigation measures are recommended. These changes and the effectiveness of the measures should be monitored. Existing statistics from Health Centres and Health Offices at Woreda level are not specific to the command areas, and in addition are partly based on observed symptoms rather than reagent tests or lab analysis (microscopy). Accurate monthly reporting is important. Therefore the following steps are recommended:

- Detailed review of existing malaria diagnostic and reporting system in each project area (procedures, quality).
- (i) the identification of specific sub-sets of data that could be used to consistently characterise the incidence of malaria in the command area populations on a monthly basis, or if such data cannot be extracted, (ii) the design of a simple but reliable system of malaria monitoring to provide the necessary monthly data in each area.
- Provision of training, equipment and facilities as required to sustainably implement the system.
- Implementation of the system, commencing a full 12 months before commissioning of the systems.

#### 7.4.4.3 Schistosomiasis and Intestinal Helminths

The projects are likely to increase the risk of transmission of intestinal schistosomiasis and intestinal helminths. There is a small probability of the creation of conditions for transmission of urinary schistosomiasis. Mitigation measures are recommended. Possible changes and the effectiveness of the measures should be monitored. Existing statistics from Health Centres and Health Offices at Woreda level are not specific to the command areas, and in addition are partly based on observed symptoms rather than reagent tests or lab analysis. Accurate reporting is important. Therefore the following steps are recommended:

- Design of a survey to provide statistically-reliable data on the prevalence of *S. mansoni*, *S. haematobium* and intestinal helminths in each of the command areas.
- Provision of training and equipment, if required to implement the surveys.
- Implementation of the first survey in each area prior to commissioning of the respective schemes (month/season to be determined), and prior to the recommended mass treatment campaigns (see Section 7.4.3.2).
- Repetition of the surveys every two years, at the same time of year, throughout the life of the projects.

The surveys could be implemented by scientists from the Departments of Community Health and/or Parasitology, Gonder College of Medical Sciences (and would provide an excellent practical exercise for supervised medical students). It will be important the results are used for disease management, and therefore appropriate links should be made to the concerned health authorities at regional, zonal and woreda levels.

#### Survey concept notes - intestinal schistosomiasis and intestinal helminths:

- Sampling framework: 3 settlements per 5,000 ha, 20 households per settlement (or as indicated by statistical theory). Stools from, say, 4 persons/household, thus 80 per settlement and 240 samples in total.
- Descriptive data: enumerator name, date, woreda, kebele, household name, ages, sex, main household occupations, level of education, economic status (possibly by wealth ranking).
- Laboratory: direct microscopic examination by Kato technique.
- Results: parasite species, density of parasites' eggs by gramme of stool, relationship to location of household/settlement, age, sex, occupations, education, economic status.

#### Survey concept notes - urinary schistosomiasis:

- Same framework etc. as in stool survey (above). Urine samples, to be filtered through paper and examined.

#### 7.4.4.4 STIs and HIV/AIDS

By changing socio-economic conditions, the projects may increase the risk of STI & HIV transmission. Mitigation measures are recommended. Possible changes and the effectiveness of the measures should be monitored, both within the command areas and in nearby market centres where risky behaviour is likely to occur. Available statistics on infection are not specific to these locations. In addition, an important aspect of STI risk reduction is knowledge of changes in knowledge, attitudes and practices (changes in behaviour). Therefore the following steps are recommended:

- Detailed review of existing STI and HIV diagnostic and reporting system in each project area (procedures, quality).
- The design of a simple but reliable system of (i) prevalence monitoring, and (ii) behaviour monitoring, including gender roles and generation relationships.
- Provision of training, equipment and facilities as required to sustainably implement the system.
- Implementation of the system, commencing (if possible) prior to construction, with regular prevalence reporting and repetition of the behaviour surveys every three years.

Note: these systems and surveys should be developed with full participation by and technical support from the national AIDS programme.

#### 7.4.4.5 Malnutrition

The success of the projects in improving people's lives can be measured by many indicators. One of the most important would be the nutritional status of children in command area households. The ideal method would be repeat nutritional surveys of children aged 2 to 9 years of age using anthropomorphic data (weight and height for age). Such surveys are simple but require some time in the field, together with accurate observations and recording. The following steps are recommended:

- Design of a survey to provide statistically-reliable data on the nutritional status of children aged 2 to 9 years in each command areas.
- Provision of training and equipment, if required to implement the surveys.
- Implementation of the first survey in each area prior to commissioning of the respective schemes (month/season to be determined).
- Repetition of the surveys every two years, at the same time of year, until no longer required.

#### 7.4.4.6 Accidents

Patients presenting with injuries as a result of accidents at Health Posts, Health Centres and Hospitals should be recorded in the usual way, with their kebele of residence and, if possible, a brief description of the cause or circumstances. The baseline should use statistics from years up to the year of construction.

#### 7.4.4.7 Pesticide Exposure

Monitoring pesticide exposure and the health effects of pesticides is not easy. In view of the future regional importance of intensive agriculture, it is suggested that a programme be developed to create, in the medium term, a specialist service and surveillance capability at regional level.

### 7.4.5 Health Organisation and Strengthening

Health organisation is the responsibility of the ANRS Bureau of Health (BoH) and falls within the general Ethiopian health sector framework. Irrigated agriculture and horticulture is a major, fast-developing sector in the region, specifically in the Lake Tana Basin. It has specific health consequences and requirements, and a regional response is indicated.

Various sections in this document have illustrated the direct links between the planned rural development interventions and the top causes of morbidity in the area. They have also highlighted the importance of preventive interventions, for which financing should not come from user fees but rather be considered a collective investment. Further discussion between the project partners will be needed to determine exactly how the budgetary requirements can be met during project construction and operation.

Economic access to health care has been identified as a key constraint for project area residents. Options for overcoming this constraint during scheme operation include (i) using a small proportion of the compulsory water user fees for health insurance, and (ii) linking health insurance with microcredit in some way.

These interventions could have a major impact on women's health and considerably improve the chances of the project meeting its developmental objectives.

The immediate requirement is for:

- **Establishment of a regional health committee to plan for implementation of health measures in relation to (initially) the Megech and Ribb irrigation projects, using this document as a starting point.**

A precedent for such a committee already exists in relation to the Koga Irrigation Project.

The committee's responsibilities should include development of (i) detailed programmes for health service response to the various irrigation schemes, (ii) details of required health service capacity upgrades, and (iii) budgets and sustainable financing mechanisms.

## 7.4.6 Costs and Financing

### 7.4.6.1 Construction Phase

#### Health and Safety

- All occupational health and safety measures associated with construction should be covered by the two projects' investment cost budgets. This includes (i) measures to be implemented by the contractors in accordance with the provisions of their respective contracts, (ii) supervision costs.
- Actual costs are to be determined.

#### STIs and HIV/AIDS

- Financing for measures to reduce and manage this construction-related health risk should be included in the two projects' investment cost budgets. As with Health and Safety, this includes both (i) the contractors' costs, and (ii) supervision costs. In addition, (iii) the cost of health measures implemented by public sector agencies specifically to protect the public from construction-related health risks should be allocated to and provided from the investment costs.
- The actual costs will be determined after full details of the measures have been agreed.

### 7.4.6.2 Operation Phase

#### Malaria

Financing for malaria control in Ethiopia is available from the Global Fund to Fight AIDS, Malaria and Tuberculosis ([www.theglobalfund.org/](http://www.theglobalfund.org/)), the Carter Centre, and the US President's Malaria Initiative (PMI: [www.fightingmalaria.gov/](http://www.fightingmalaria.gov/)). No additional funding is necessary, but advocacy may be required to target available budgets towards the project areas.

To this end, it would be worthwhile for the project to undertake a survey of LLIN coverage and use in the project areas and, according to the results, develop an advocacy approach to the national malaria programme (workshops, lobbying by project key stakeholders).

- Alternatively, malaria mitigation and monitoring costs could be treated as necessary investment and operational costs to achieve project objectives, and funded from water user fees.
- Actual costs are to be determined.

#### Schistosomiasis and intestinal helminths

- The cost of mass treatment against *Schistosoma* and intestinal helminths would be about USD 0.50 per year per individual if the drugs are distributed through existing health facilities. Financing for mass treatment should be planned for at least five years, since this is the time required to observe a beginning of changes in human behaviour, and this only if the health and education/awareness services are functioning well.
- The cost of each survey would be well below USD 10,000 (exact costs to be determined).

### STIs and HIV/AIDS

- In general, the strategies implemented by the national AIDS control programme are appropriate, and sufficient resources are mobilised through the Global Fund and PEPFAR support to implement them.
- Diverting resources to focus on specific risk groups and locations (such as the projects' market centres) will require advocacy based on good monitoring data. Therefore the projects should implement reliable surveys (see Section 7.4.4.4 above).
- An indicative USD 50,000 for each round of the survey (every 3 years) may be sufficient to document changes, depending on the exact design of the surveys and local capabilities.

### Malnutrition

General education, especially female literacy, should be covered from education budgets targetting the command areas.

Integrating nutrition into health education and awareness packages: indicative cost USD 10,000.

Promotion of homestead gardens and livestock micro-enterprises: should be covered by livelihood and microfinance interventions.

Nutritional survey of children before commissioning and during project operation: indicative cost \$ 5,000 each survey campaign.

#### 7.4.6.3 Institutional Strengthening and Training

The costs of health-related institutional strengthening and training to implement the measures recommended in this report are to be determined following development of the detailed practical programme by the Bureau of Health and its partners.

## 7.5 CONCLUSIONS

### 7.5.1 Findings

The main health hazards in the PCA are vector-borne tropical diseases especially malaria, intestinal schistosomiasis and soil-related intestinal helminths. At this Latitude, the elevation of 1800 m asl is compatible with the cycles of transmission of all these diseases, and they are widely observed in the population. They are the principal diagnosis done in the health facilities, and the origin of the major part of the prescriptions.

The lack of permanent roads inside the two areas is of importance for health. During the rainy season and the beginning of the dry season - at least during six months each year - the only way to travel within the command areas is on foot (or by donkey) or by boat. Professional health workers are rarely present inside the command areas, largely due to difficult access, and it is difficult for patients to physically or financially access health care.

Knowledge, attitudes and practice in relation to health amongst the local residents are low, in keeping with extreme poverty, illiteracy and strong cultural traditions.

The entire local population can be considered a risk group in relation to the main existing health hazards and to the hazards which are likely to be changed or intensified by the project - malaria, schistosomiasis and intestinal helminths. Within this overall population, the most vulnerable groups are women, small children and the landless.

Specific project-related hazards will affect different risk groups, e.g. farmers and contract sprayers will be most exposed to pesticides.

The health services are working hard to meet the directly health-related MDGs (Goal 4: reduced child mortality; Goal 5: improved maternal health; Goal 6: combating HIV/AIDS, malaria and other diseases, and Goal 7, ensuring environmental sustainability - especially access to safe water) but suffer from resource constraints which affect staffing, skills, equipment, facilities, operations and training. Consequently most command area residents neither have access to safe water nor are able to easily physically access health care facilities. In addition both health prevention and most curative services require cash, and major economic barrier to the majority of the population.



The irrigation and drainage schemes at Megech (at Seraba) and in the Fogera plain (Ribb) will not radically transform the environment of these areas since they are already floodplains with permanent wetlands. Vector-borne diseases, especially malaria and intestinal schistosomiasis, soil-related parasites, respiratory infections and diarrhoeas are common. The pattern of transmission and the incidence of these diseases will change to some degree as a result of operation of the projects, but not radically:

- **Malaria will probably be present during a longer period of the year.** The most important measure to reduce its impact is improved use of impregnated bednets and better access to rapid diagnosis and efficient treatments.
- **Intestinal schistosomiasis transmission will probably increase.** Initially systematic mass treatments will be the best way to reduce the heavy infections. In the long term, education and improved living standards may result in an improvement in sanitation (e.g. use of latrines) and a decrease of the contamination of the snails by human beings, the sole method of long-term bilharzia prevention. The reduction of helminths infections is similar: repeated mass treatments and improved sanitation and hygiene.

The project will introduce or intensify some health hazards which, currently, are at relatively low levels. These include accidents (vehicles, machinery), HIV/AIDS, pesticides, and the health and safety risks of water to small children.

The project, as currently designed, will have no impact on many of the endemic diseases affecting local residents such as diarrhoeas, ARTIs, TB and trachoma. These are likely to remain at unacceptably high levels unless specific measures are applied, together with the **three key interventions** of:

- **All-weather roads.**
- **Safe water.**
- **Adult literacy, especially for women.**

Furthermore, **it is unlikely that the project will meet its developmental goals unless the burden of disease can be significantly reduced.** This will require non-agricultural interventions, both in health services and other sectors such as adult education and domestic water supplies.

In a long term, at least one human generation, if the agricultural activities are successful and social and other services well developed (education, health, roads, etc.), the irrigation schemes will result in a general improvement of health.

## 7.5.2 Next Steps

Recommended next steps are:

- (i) Circulate this report to the Bureau of Health in Bahir Dar, for their consideration and action as the responsible regional government agency.
- (ii) Establish a formal irrigation project-related health committee in the region under the BoH to determine further actions in partnership with ENIDP's main stakeholders: MoWE and MoARD, together with the projects' international sponsor, the World Bank.

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## 7.7 APPENDIX 1 - PEOPLE AND ORGANISATIONS CONTACTED

Name	Position / Affiliation	Contact
<b>BAHIR DAR</b>		
Dr. Asrat Genet	Head, Regional Health Bureau	0918-340-523, 0582-200-922
Dr. Ali Gebeyehu	Deputy Head, Regional Health Bureau	0918-340-914
Fekadu Sedeta	HIV/AIDS Prevention Officer	0918-701-115
Shuji Noda	Coordinator, JICA AmRIDS Project	0918-020-725
<b>DEMBIA WOREDA</b>		
<b>Kola Diba</b>		
Alemneh Banti	Chair, Woreda Project Implementation Team (WPIT)	0583-350-002
Deresegn Fente	Head, Health Office	0583-350-019
Sebsibachew Atnafu	Head, Land Management Office	
<b>Chuahit</b>		
Tabor Mengistu	Supervisor, Health Centre	
	Nurses and laboratory technicians	
<b>Gorgora</b>		
Sr. Adina Alemu	Head, Health Centre	
<b>LIBO KEMKEM WOREDA</b>		
<b>Addis Zemen</b>		
Bitew Alebachew	Deputy Head, Agriculture Office	
Addisu Berhanu	Manager, Area Development Programme, World Vision International	0911-761-554
<b>Yifag</b>		
Addis W/Mariam	Nurse, Yifag Health Centre	
<b>Bura</b>		
Alemtsehay	Community Health Assistant	
<b>FOGERA WOREDA</b>		
<b>Woreta</b>		
Sr. Haimanot Firde	Deputy Head, Health Office	0584-460-449
Worku Mulat	Head, Agriculture Office	
<b>Addis Betekristian Kebele</b>		
Sr. Astatkiw Selamu	Head, Addis Betekristian Clinic	

## 7.8 APPENDIX 2 - ITINERARY

### Itinerary of Rapid Health Appraisal

Date	Location
<b>2009</b>	
14 Oct.	Travel AA - Bahir Dar
15 Oct.	Bahir Dar - Bureau of Health; travel to Woreta (Fogera Woreda HQ - Health Office, Health Centre) and to Ribb River dam site: meet engineering staff
16 Oct.	Addis Betekristian Health Centre; Addis Zemen (Libo Kemkem Woreda HQ - health & agriculture staff); Bura Health Post; Yifag Health Centre
17 Oct.	Yifag Health Centre; travel to Addis Zemen - Agriculture Office; travel to Dembia Woreda; attempt to reach Guramba and Robit (road impassable)
18 Oct.	Analysis and reporting
19 Oct.	Travel to Kola Diba (Dembia Woreda HQ - Head of WPIT; Kola Diba Health Centre)
20 Oct.	Aberjeha Health Post; Gorgora Health Centre; Chuahit Health Centre; Woreta Health Office; return to AA
21 Oct.	Analysis and report preparation
22 Oct.	Analysis and report preparation
23 Oct.	Meeting with Project Coordinator, MoWR
<b>2010</b>	
04 Mar.	Travel AA - Bahir Dar
05 Mar.	Bahir Dar - Bureau of Health; JICA AmRIDS project; travel to Woreta and Addis Zemen - Woreda Health Offices
06 Mar.	Travel to Addis Zemen to collect health data; meeting in Bahir Dar with Head of ANRS BoH
07 Mar.	Travel Bahir Dar - AA

## 7.9 APPENDIX 3 - HEALTH DATA

### 7.9.1 Dembia Woreda

**Table A3.1: Malaria - reported cases and incidence (per 10,000 inhabitants), Dembia Woreda, 1-30 September, 2002**

Note 1: MPIDP beneficiary kebeles are shaded.

Note 2: Some kebele boundaries and names have changed since 2002.

Kebele	Population (2002)	No. of Cases	Incidence ( per 10,000)
Jangua	4,462	414	928
Chenker Cherkose	7,726	347	449
Guramba Bata	5,108	224	439
Darena	5,572	189	339
Fenja	6,951	195	281
Atakilt	6,446	179	278
M/Kirestos	5,181	126	243
Wokerako	5,678	131	231
Guarhe	8,290	189	228
Kolladiba	15,537	338	218
Tana Wonja	7,097	148	209
Seraba Dabelo	6,553	132	201
Gurandi	4,933	93	189
Salji Chillo	5,850	102	174
Tezeba	5,864	102	174
Chuahit	8,625	126	146
Gu/Michael	4,956	72	145
Jenda	6,947	101	145
Debir Zuria	10,148	140	138
Sufankara	9,599	111	116
Arebia	7,222	83	115
Jarjar	7,062	71	101
Gorgora	4,720	46	97
Sankisa	3,074	27	88
Ayemba	2,240	19	85
Gerargie	3,915	33	84
Ambagualit	4,481	30	67
Semra	6,930	46	66
Fentaye	8,060	43	53
Mequamia	9,945	53	53
Achera Mariam	3,343	17	51
Senbet Debir	6,056	31	51
Aberjeha Dhena	9,901	48	48
Mangie	3,757	17	45
Hana	2,776	8	29
Buwa	10,178	25	25
Gana	10,294	22	21
Dermara	5,431	8	15
Abaworam	5,661	8	14



Kebele	Population (2002)	No. of Cases	Incidence ( per 10,000)
Gendewa	9,542	13	14
Wawocha	6,525	5	8
Jeri	4,672	1	2
Chenkela	6,381	0	0
Guntir	4,583	0	0

Source: Malaria Investigation Report (unpublished) JICA AmRIDS, 2010

**Table A3.2: Top Five Diseases, Dembia Woreda, June 2009 to Sep. 2010**

For comparison with Table 1 in the main text of this appraisal, Table A3.2 shows the top five diseases in Dembia Woreda according to a JICA-supported infectious disease surveillance project ("AmRIDS"), as reported by local health facilities in Dembia Woreda in Ethiopian year 2002 (2009/10 GC).

No.	Disease	No. of Cases
1	Malaria	10,587
2	Pneumonia	618
3	Diarrhoeal diseases (non-bloody)	651
4	Urinary tract infections	146
5	Diarrhoeal diseases (bloody)	135
Note	New AIDS cases	6

Source: JICA AmRIDS project, Bahir Dar, 2010 (unpublished data)

## 7.9.2 Fogera Woreda

Table A3.2: HIV/AIDS - voluntary counselling and testing results in Fogera Woreda between July 2008 and June 2009

Age Group	Pre-test counselled		HIV tested		No. HIV positive	
	Male	Female	Male	Female	Male	Female
< 15	86	37	86	37	1	0
15-19	855	532	855	532	2	1
20-24	1022	535	1022	535	2	2
25-29	1057	535	1057	535	4	4
30-34	870	260	870	260	3	4
35-39	635	183	635	183	4	1
40-44	476	165	476	165	4	2
45-49	257	103	257	103	2	2
≥50	319	81	319	81	1	0
Total	5577	2431	5577	2431	23	16

Source: Fogera Woreda Health Office, 2001 E.C. Annual Report

Table A3.3: Total number of outpatients, number of suspected malaria cases and confirmed malaria cases reported by age group in Fogera Woreda between July 2008 and June 2009

Age Group	Total no. outpatients	No. suspected malaria cases	No. blood films done by microscopy	Number confirmed cases by malaria species		
				Plasmodium falciparum	Plasmodium vivax	Mixed infection
<1	3713	1410	1469	526	10	0
1-4	8824	3787	3531	1240	105	5
5-14	12892	7237	6484	2723	182	10
≥15	32871	15357	14030	7154	388	23
Total	58300	27791	25514	11643	685	38
Pregnant women	7154	710	954	199	38	0

Source: Fogera Woreda Health Office, 2001 E.C. Annual Report

Table A3.4: Top ten causes of morbidity in under-five children reported in Fogera Woreda between July 2008 and June 2009

No.	Diagnosis	Total no. cases	Percent from all cases* (%)
1	Malaria	2002	38
2	Diarrhoeal diseases	1319	25
3	Pneumonia	959	18
4	Trachoma	175	3.3
5	Eye infection other than trachoma	169	3.3
6	Acute upper respiratory infections	137	2.6
7	Infection of skin & subcutaneous tissue	136	2.6
8	Ear infection & mastoiditis	120	2.3
9	Helminthiasis	105	2
10	Tonsiopharyngitis	80	1.5

\* Total number of all cases is 5318.

Source: Fogera Woreda Health Office, 2001 E.C. Annual Report

### 7.9.3 Libo Kemkem Woreda

Table A3.5: Top ten causes of morbidity in under-five children reported from Libo Kemkem Woreda between October 2008 and January 2009

No.	Diagnosis	Cases	Percent of all cases* (%)
1	Malaria (non-lab confirmed)	1276	37
2	Diarrhoeal diseases (non-bloody)	557	16.3
3	Malaria (confirmed <i>P. falciparum</i> )	321	9.4
4	Diarrhoeal diseases (bloody)	262	8.2
5	Pneumonia	253	8.0
6	Intestinal parasites	141	4.1
7	Diarrhoea with dehydration	138	4.0
8	Acute upper respiratory infection	134	4.2
9	Ear infection	58	1.7
10	Severe malnutrition	45	1.3

\* Total number of all cases is 3408.

Source: Libo Kemkem Woreda Health Office, Quarterly Report, Oct. 2008-Jan 2009

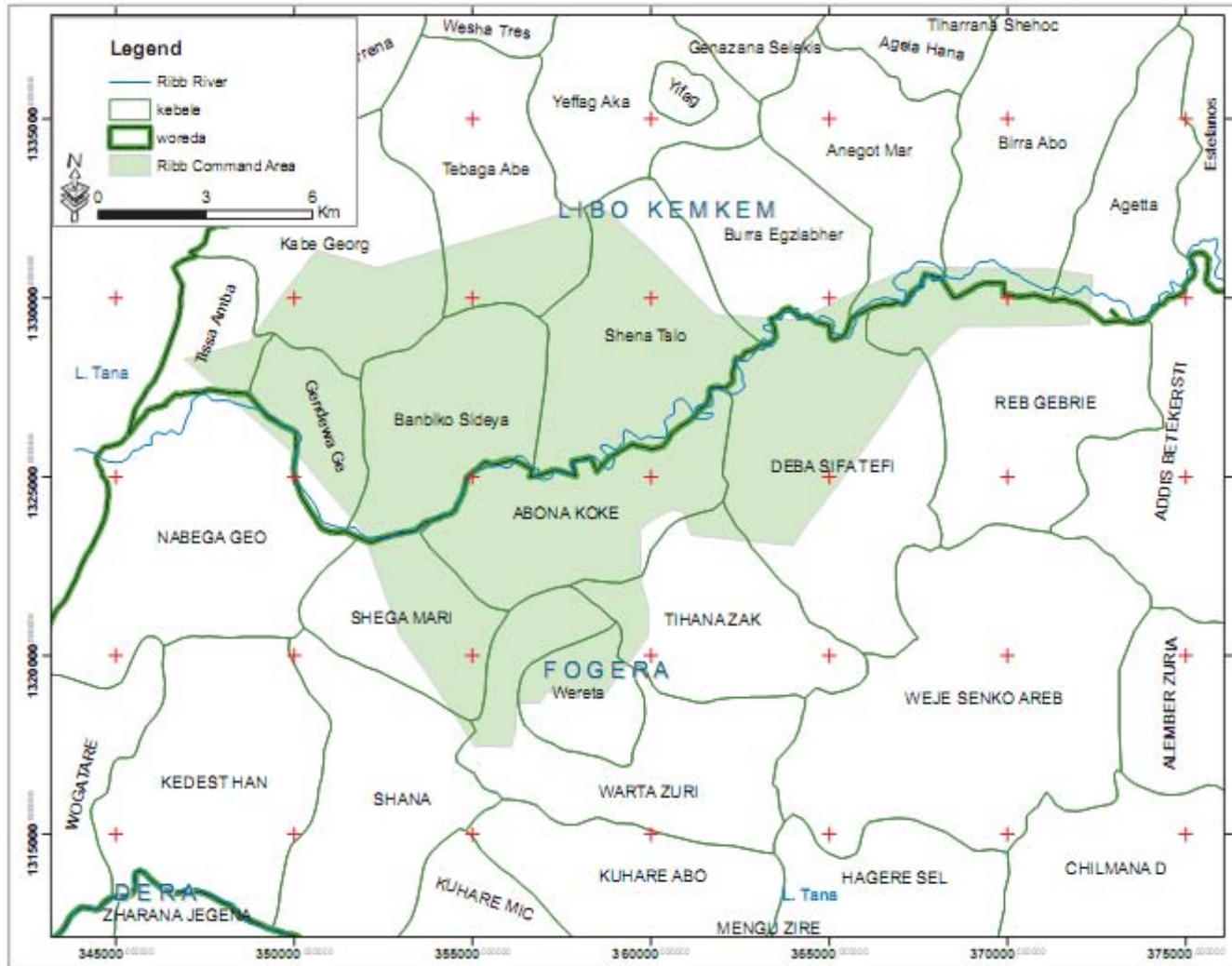
## 7.10 APPENDIX 4 - MAPS

Map 1: Megech Pump (Seraba) Irrigation and Drainage Project

Map 2: Ribb Irrigation and Drainage Project



**Map 2: Ribb Irrigation and Drainage Project - Command Area and Kebele Boundaries**



## 8. Annex 8 - Pest Management Plan

### ESIA REPORT ON MEGECH PUMP (SERABA) IRRIGATION & DRAINAGE PROJECT

#### *Phase 1 Pest Management Plan*

##### TABLE OF CONTENTS

List of Tables	8-2
List of Photos	8-2
Abbreviations	8-3
<b>8.1 INTRODUCTION .....</b>	<b>8-4</b>
8.1.1 Authors	8-4
8.1.2 Background	8-4
8.1.2.1 The Study	8-4
8.1.2.2 World Bank Policy	8-4
8.1.3 Purpose and Contents of this Phase 1 PMP	8-5
8.1.3.1 Purpose	8-5
8.1.3.2 Contents	8-5
<b>8.2 CURRENT SITUATION.....</b>	<b>8-6</b>
8.2.1 Pests and Diseases in the Command Area	8-6
8.2.1.1 Crop Pests and Diseases	8-6
8.2.1.2 Vertebrate Pests	8-7
8.2.1.3 Livestock Pests and Diseases	8-8
8.2.2 Pest Control Practices in Command Area	8-8
8.2.2.1 Crops	8-8
8.2.2.2 Livestock	8-8
8.2.2.3 Human Resources	8-9
8.2.3 Regulatory and Institutional Framework	8-10
8.2.3.1 Policy, Laws and Regulations	8-10
8.2.3.2 Institutions	8-10
8.2.4 Experience with IPM	8-11
8.2.4.1 IPM	8-11
8.2.4.2 National Experience with IPM	8-11
8.2.4.3 Local Experience with IPM	8-11
<b>8.3 FUTURE SITUATION WITH AND WITHOUT MITIGATION .....</b>	<b>8-12</b>
8.3.1 Feasibility Study Proposals for Pest Management	8-12
8.3.2 Impact Scenarios	8-12
8.3.3 Risks	8-12
8.3.4 Compliance of Project with IPM Principles	8-13
8.3.5 To Move Towards IPM	8-13
8.3.5.1 Objectives	8-13
8.3.5.2 Capacity Building for IPM	8-13

8.3.5.3	Possible Activities and Development of Phase 2 PMP	8-14
8.3.5.4	Authorised Pesticides	8-18
8.3.5.5	Monitoring and Evaluation	8-18
8.3.5.6	Indicative Budgets	8-18
<b>8.4</b>	<b>REFERENCES.....</b>	<b>8-20</b>
<b>8.5</b>	<b>APPENDIX 1: PERSONS AND ORGANISATIONS CONTACTED.....</b>	<b>8-21</b>
<b>8.6</b>	<b>APPENDIX 2: ITINERARY.....</b>	<b>8-22</b>
8.6.1	Megech Pump (Seraba) Irrigation and Drainage Project	8-22
8.6.2	Ribb Irrigation and Drainage Project	8-23
<b>8.7</b>	<b>APPENDIX 3: LISTS OF BANNED AND REGISTERED PESTICIDES .....</b>	<b>8-24</b>
8.7.1	Banned Pesticides	8-24
8.7.2	Registered Pesticides, April 2010	8-24
8.7.2.1	List of Registered Pesticides (Insecticides)	8-25
8.7.2.2	List of Registered Pesticides (Herbicides)	8-29
8.7.2.3	List of Registered Pesticides (Fungicides)	8-32

## LIST OF TABLES

Table 8-1	Crops: Relative Importance of Different Pests and Diseases .....	8-6
Table 8-2	Insect Pests in Dembia Woreda.....	8-6
Table 8-3	Crops: Common Diseases .....	8-6
Table 8-4	Crops: Common Weeds .....	8-7
Table 8-5	Pesticides used in Dembia Woreda .....	8-8
Table 8-6	Draft Planning Matrix, for development during Phase 2 .....	8-15
Table 8-7	Components, Activities and Expected Results of PMP .....	8-16
Table 8-8	Indicative Costs of Typical PMP Activities in the Field (ETB) .....	8-19

## LIST OF PHOTOS

Photo 8-1	Aphid treatment, Grass peas (Guaya), Lake Tana area, Jan. 2009 .....	8-9
Photo 8-2	Farmer Training Centre, Kaha, Megech Command Area, 2010 .....	8-9

## ABBREVIATIONS

ARARI	Amhara Region Agricultural Research Institute
BP	Bank Procedure
Bt	Bacillus thuringiensis
BoARD	Bureau of Agriculture and Rural Development
BoEPLAU	Environmental Protection, Land Administration and Use Bureau (formerly EPLAUA)
BoWRD	Bureau of Water Resource Development
DDT	Dichlorodiphenyltrichloroethane
EA	Environmental Assessment
EMP	Environmental Management Plan
ENRIDP	Ethiopian Nile Irrigation and Drainage Project
EPLAUA	Environmental Protection, Land Administration and Use Authority (now BoEPLAU)
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
FAO	Food and Agriculture Organisation of the United Nations
IPM	Integrated Pest Management
IVM	Integrated Vector Management
MARD	Ministry of Agriculture and Rural Development
MCE	Metaferia Consulting Engineers
MoFED	Ministry of Finance and Economic Development
MoWE	Ministry of Water and Energy (formerly MoWR)
MoWR	Ministry of Water Resources (now MoWE)
MPIDP	Megech Pump (Seraba) Irrigation and Drainage Project
NGO	Non Governmental Organization
OP	Operational Policy
PHC	Plant Health Clinic
PMP	Pest Management Plan
POP	Persistent Organic Pollutant
QSAE	Quality and Standards Agency of Ethiopia
RIDP	Ribb Irrigation and Drainage Project
SC-UK	Save the Children - United Kingdom
TOR	Terms of Reference
TOT	Training of Trainers
URL	Uniform resource locator
WB	World Bank
WHO	World Health Organisation



## 8.1 INTRODUCTION

### 8.1.1 Authors

Agronomist/Extension Expert, responsible for field surveys and report preparation:

Tibebu Tessema

email: <tmb@ethionet.et>, tel: 00-251-911-428-350

ESIA Team Leader, responsible for report expansion and editing:

James Ramsay

Environmental Specialist, BRLi, France

Email: <jramsay@horizon.bc.ca>, tel: 0910-196-376

### 8.1.2 Background

#### 8.1.2.1 The Study

BRL (France) in association with Metaferia Consulting Engineers (MCE: Ethiopia) has been awarded a contract by the Ministry of Water Resources (MoWR) to carry out an Environmental and Social Impact Assessment (ESIA) study of three proposed irrigation and drainage schemes. Two of the schemes are located in the floodplains around Lake Tana (Megech at Seraba, a pumped scheme, and Ribb, dependent on a dam and reservoir). This Pest Management Plan (PMP) relates to the Megech and Ribb schemes.

The proposed Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) is located on the north side of Lake Tana in Dembia Woreda. Some 4,000 of low-lying land will be irrigated from the lake by pumping to a main canal and subsequent gravity irrigation. It is intended that the existing small-holder mixed farming system based on flood recession and rainfed cropping and livestock husbandry will be transformed into a commercially-oriented agricultural system, based on reorganised small-scale family farms. The Ribb Irrigation and Drainage Project (RIDP) is similar, except that it will use water stored behind a dam on the Ribb River (now under construction), and will service two woredas, Fogera and Libo Kemkem.

#### 8.1.2.2 World Bank Policy

The projects' international sponsor is the World Bank ("the Bank", or WB). One of the Bank's operational policies (OP) concerns pest management (OP 4.09 *Pest Management*, Dec. 1998). The policy states that:

In assisting borrowers to manage pests that affect either agriculture or public health, the Bank supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. In Bank-financed projects, the borrower addresses pest management issues in the context of the project's environmental assessment.

In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity.

OP 4.09 applies to all Bank lending, whether or not the loan finances pesticides. Even if Bank lending for pesticides is not involved, an agricultural development project may lead to substantially increased pesticide use and subsequent environmental problems - as in this case. Therefore the policy applies to both the MPIDP and RIDP.

The policy also states that:

In Bank-financed agriculture operations, pest populations are normally controlled through IPM approaches, such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest (see Section 8.2.4.1).

Procedures for assessing pest management issues are described in the Bank's policy on environmental assessment (OP 4.01 *Environmental Assessment*, Jan. 1999), specifically in Annex C of the supporting Bank Procedure (BP 4.01 - Annex C *Application of EA to Projects Involving Pest Management*). When significant pest management issues are associated with a project, the environmental management plan (EMP) developed during the EA process should include a pest management plan (PMP: see Box).

## Box 1

## Pest Management Plan

A pest management plan is a comprehensive plan, developed when there are significant pest management issues such as (a) new land-use development or changed cultivation practices in an area, (b) significant expansion into new areas, (c) diversification into new crops in agriculture, (d) intensification of existing low-technology systems, (e) proposed procurement of relatively hazardous pest control products or methods, or (f) specific environmental or health concerns (e.g., proximity of protected areas or important aquatic resources; worker safety).

A pest management plan reflects the policies set out in OP 4.09, *Pest Management*. The plan is designed to minimize potential adverse impacts on human health and the environment and to advance ecologically based IPM.

Source: BP 4.01 - Annex C (World Bank 1999)

## 8.1.3 Purpose and Contents of this Phase 1 PMP

### 8.1.3.1 Purpose

Both the Environmental and Social Management Framework (ESMF) for the Ethiopian Nile Irrigation & Drainage Project (ENIDP) and the Terms of Reference (TOR) for the project's Environmental and Social Impact Assessment (ESIA) specify the preparation of a pest management plan (PMP).

BP 4.01 - Annex C describes a two-phase procedure for developing a PMP. The first phase of the plan - an initial reconnaissance to identify the main pest problems and their contexts (ecological, agricultural, public health, economic, and institutional) and to define broad parameters - is carried out as part of project preparation and is evaluated at appraisal. The second phase - development of specific operational plans to address the pest problems identified - is often carried out as a component of the project itself.

Accordingly, an initial reconnaissance has been carried out involving (i) desktop review of available information, (ii) meetings with relevant national, and regional institutions, (iii) meetings with key informants in the project area. The results are presented in this report which is intended to:

Meet the requirements for a Phase 1 Pest Management Plan for the MPIDP in terms of Bank procedures for project preparation.

Establish the basis for development of a Phase 2 Pest Management Plan early in project implementation (further steps noted in the Bank's annotated TOR for preparation of a PMP in the Africa Region<sup>1</sup> are (i) a stakeholders consultation; (ii) elaboration of the second phase of the PMP; (iii) a second stakeholders consultation; and (iv) finalisation of the PMP).

### 8.1.3.2 Contents

This Phase 1 PMP addresses the four major issues noted in Bank guidelines for PMPs under the two main headings "Current Situation" and "Future Situation with and without Mitigation". The four major issues are:

- Pest management approaches
- Pesticide use and management
- Policy, regulatory framework and institutional capacity
- Monitoring and evaluation

Outline Terms of Reference (TOR) for development of a Phase 2 PMP are attached at Annex 12 of this volume.

<sup>1</sup> WB website. Annotated Terms of Reference for the Preparation of a Pest Management Plan (PMP). For URL see References.<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/EXTPESTMGMT/0,,contentMDK:20378805~menuPK:1613999~pagePK:64168445~piPK:64168309~theSitePK:584320~isCURL:Y,00.html>

## 8.2 CURRENT SITUATION

### 8.2.1 Pests and Diseases in the Command Area

#### 8.2.1.1 Crop Pests and Diseases

Farmers in the Megech command area practise un-mechanised mixed agriculture on small plots. Cereals are grown as a staple, with additional crops being pulses, oilseeds and small amounts of vegetables and spices, some of which are sold for cash. Cattle are kept for draught power (cultivation) and other products and services such as milk, manure, and cash in kind, donkeys are kept for transport. Other important livestock are sheep, goats and poultry, with beekeeping an important enterprise for many farmers.

The major cereal crops are teff, sorghum and maize, in that order. Chickpeas are the most important pulse (legume). The cropping intensity is around 113% (Table B.1-9, MPIDP FS).

Crop pests and diseases cause major economic losses. The relative importance of different causes in the project area is illustrated in Table 1. Although no systematic loss assessments have been undertaken in Amhara region, the annual losses are believed to be very high, with annual pre-and post-harvest losses estimated at 20-30% and 10% respectively (Bahir Dar Plant Health Clinic (PHC)). Horticultural crops are at especial risk.

**Table 8-1 Crops: Relative Importance of Different Pests and Diseases**

Pest or Disease	Proportion of Damage (%)
Insects	37
Weeds	26
Storage pests	20
Plant diseases	12
Other (inc. birds, rats etc.)	5

Source: adapted from Table B.1-19, MPIDP Feasibility Study

Common insect pests in the command area are listed in Table 2. These fall into two major categories: migratory pests such as the African armyworm (*Spodoptera exempta*), with outbreaks which formerly occurred about every four years now occurring more often, causing considerable damage to cereals and grasses, and regular or endemic pests such as red teffworm, barley shoot fly, grasshoppers, cutworms and stalk borers.

**Table 8-2 Insect Pests in Dembia Woreda**

Insect Pest	Crop	Extent of Damage
Barley shootfly	Teff, barley	High
Grasshopper	Millet, teff, maize, sorghum	High
Cutworm	Cotton, tomatoes, peppers, pulses	High
Stalk (stem) borer	Maize, sorghum	High
Aphids	Vegetables, barley	High
Armyworm	Cereal, grasses	Very High

Source: adapted from Table B.1-20, MPIDP Feasibility Study

As is indicated in a recent ARARI report (Akalu Teshome *et al.* 2009), the species composition of pests is more or less the same among the three project woredas. All of them lie within the same agroecozone and ecological context, i.e. the floodplains of around Lake Tana.

Crop diseases are also a major production constraint (Table 3).

**Table 8-3 Crops: Common Diseases**

Disease	Crop	Extent of Damage
Root rot	Hot peppers, shallots, onions, chickpeas	Medium
Rust	Barley, wheat, sorghum, maize	
Septoria	Wheat	
Powdery mildew	Peppers, potatoes, onions	
Late blight	Potatoes	

Source: adapted from Table B.1-24, MPIDP Feasibility Study

All crops are affected by weeds (Table 4). Some of the most serious damage is caused by parasitic weeds such as Striga and Field dodder. Striga can cause total crop loss in maize and sorghum. Numerous other weeds affect crops, springing up every year depending on crop type, farming system, rainfall, flood intensity, antecedent crops and cultivations, etc. Farmers' perceptions are that weed infestation and diversity is rapidly increasing, especially closer to the lake: floods bring silt, but also weeds. A significant new problem is the invasion of grazing areas by unpalatable species such as *Amekyla* (*Hygrophila auriculata*) and *Yemogn fir* (*Xanthium strumarium*: Common or Rough Cocklebur).

**Table 8-4 Crops: Common Weeds**

Weed	Common Name	Crop	Extent of Damage
<i>Striga hermontica</i>	Striga ( <i>Gelimit</i> )	Maize, sorghum, millet, teff	High
<i>Cuscuta campestris</i>	Field dodder	Niger seed, pepper, sesame	High
<i>Amaranthus hybridus</i>	Rough pigweed	Teff, sorghum, maize, wheat, barley	Medium
<i>Avena abyssinica</i>	Abyssinian oat	Barley, wheat	
<i>Bidens pilosa</i>	Spanish needle	Teff, sorghum, maize, wheat, barley, peas	
<i>Datura stramonium</i>	Jimsonweed, angel's trumpet, thorn apple	All crops	
<i>Galinsoga parviflora</i>	Gallant soldier	Teff, sorghum, maize, wheat, barley	
<i>Guizotia scabra</i>	Sunflecks	All crops	
<i>Medicago polymorpha</i>	Bur clover	Teff, sorghum, maize, wheat, barley	
<i>Tagetes minuta</i>	Mexican marigold	Teff, sorghum, maize, wheat, barley	

Source: adapted from Table B.1-23, MPIDP Feasibility Study

Crops are also subject to attack and spoliation during storage. Storage facilities typically comprise *gottera* (above-ground woven bamboo baskets), sacks, and *gudguad* (pit excavated in the ground). Above-ground storage is especially susceptible to attack by rats and weevils.

### 8.2.1.2 Vertebrate Pests

In addition to the ubiquitous House Mouse (*Mus musculus*) and Black Rat (*Rattus rattus*) which cause major damage to stored crops, a number of other vertebrates are considered pests in the area:

- **Birds**, especially Cranes and Geese, sometimes forage in standing crops before harvest, bringing them into conflict with farmers. Although in Ethiopia birds (like other wildlife) are protected by religious customs and (to a small extent) by law, farmers may harass and persecute birds attacking their crops.
- **Hippopotamuses** are not appreciated by local farmers, since they destroy crops and, reportedly, compact soil making cultivation difficult. The ESIA study team was informed that in June 2008 a farmer shot a hippopotamus that destroyed his crops; apparently he was not reprimanded by the authorities.
- **Aardwolves** are reported to have attacked human beings in daylight two years ago. This report cannot be verified.
- **Crested porcupine** (*Hystrix cristata*) used to be a menace in what is presently Wawa Farm, destroying crops. Since Porcupine lie up in Aardvark dens during the day, the menace was controlled by putting a price of ETB 30 on termite queens, encouraging young men to dig them out, thus reducing the number of termite colonies and consequently the numbers of Aardvark which feed on termites, and hence the number of Porcupine-friendly Aardvark dens.

Other areas around Lake Tana report crop damage from Vervet Monkey and Baboon and night-time predation by Hyaena, but these animals do not appear to cause significant problems in the Megech command area.

### 8.2.1.3 Livestock Pests and Diseases

The main livestock diseases in the area are (i) epizootic diseases (diseases which can affect a large number of animals at the same time within a particular region or geographic area), and (ii) endemic zoonotic diseases (diseases transmissible from animals to humans).

Epizootic diseases occurring in the area include contagious bovine pleuropneumonia, contagious caprine pleuropneumonia, lumpy skin disease, foot and mouth disease, Newcastle disease, and sheep and goat pox. Other economically important epizootic diseases are African trypanosomiasis (*Nagana*), endoparasitosis and ectoparasitosis (MPIDP Feasibility Study), and African horse sickness.

Endemic zoonotic diseases include bovine tuberculosis, brucellosis, cysticercosis, hydatidosis, rabies and anthrax.

## 8.2.2 Pest Control Practices in Command Area

### 8.2.2.1 Crops

At present crop pest and disease control is limited by a combination of lack of knowledge, lack of equipment, lack of supplies, and lack of finance. Dembia, Fogera and Libo Kemkem Woreda farmers, particularly the twenty eight peasant associations included in the two projects, take various measures to minimise or avoid pest infestations - use of disease resistant cultivars, weeding and some application of insecticide and herbicides. Weed control is generally achieved through a combination of tillage - seedbed preparation by several passes of the traditional ox-drawn plough (*maresha*) - and subsequent inter-row weed control cultivations in row crops. Broadcast crops such as teff are hand-weeded.

In addition to these traditional techniques, 22% of the respondents in the MPIDP's socio-economic survey reported use of herbicides. However, comprehensive data on pesticide use in the command area are not available. Statistics presented in the Feasibility Study are shown in Table 5; these data show a dramatic increase in pesticide use year on year. Note that the data exclude pesticides purchased from private vendors.

**Table 8-5 Pesticides used in Dembia Woreda**

Pesticide	Unit	2005/6	2006/7	2007/8
Liquid (endosulfan, malathion)	litre	880	1,875	2,686
Powder	kg	306	966	1,800

Source: adapted from Table E.3-6, MPIDP Feasibility Study

Pesticides in use in the project area include, for example:

**Insecticides:** malathion 50% EC, fenithrothion 50% EC, endosulfan 35% EC, diazinon 60% EC, and chlorpyrifos-ethyl 48% EC, for various insect pests in crops. Also, unauthorised insecticides such as DDT are used for the control of red teff worm and household pests. DDT is officially banned (see Annex 3), but its use in agriculture is reported by the Bahir Dar Plant Health Clinic. The source is unknown - the only legal use of DDT is for malaria control by the Bureau of Health.

**Herbicides:** broadleaf weeds in the cereals teff, wheat, maize and sorghum may be controlled by applying 2,4-D 720 g/l A.E.

**Fungicides:** mancozeb, used against tomato and potato blights.

**Storage:** pirimiphos-methyl 2% dust and aluminium phosphide 56% tablets may be used for the control of storage pests. Thiram 80% wp is used for the control of seed decay in sorghum and maize. Bromadiolone rodenticide is used for the control of rats in both houses and stores.

Control of birds and wild animals is mainly by traditional methods: scaring and chasing by persons protecting the crops and fields.

### 8.2.2.2 Livestock

The Woreda, Zonal and Regional Bureaus of Agriculture and Rural Development (WoARD, ZoARD and BoARD) provide veterinary services for livestock, including vaccines against epizootic and endemic zoonotic diseases. Internal parasites are treated by applying de-worming techniques every 3 -6 months. External parasites such as ticks and others are treated by spraying or by dipping sick animals at the vet clinics, formerly using organophosphate insecticides and now using other insecticides, including formulations of diazinon and deltamethrin.

### 8.2.2.3 Human Resources

Studies of pesticide use in Ethiopia indicate that although farmers are aware that pesticides are poisonous, their responses still create "a major occupational health risk" (Arne 2004). In particular, some pesticides are often sold in non-standard containers without instructions in Amharic, effective protective clothing and equipment is seldom available, on-farm storage sites are highly hazardous, used containers are washed out in local waterbodies and the containers re-used, and attitudes reveal low knowledge of safe practices (see, e.g. Mekonnen & Agonafir 2002).

A group at special risk is the "professional sprayers" who have their own spraying equipment (typically a back pack) and work for hire (Photo 8-1).

Data on pesticide poisoning and environmental contamination in Ethiopia is very difficult to obtain because no system exists for regular monitoring of the risks associated with pesticide use. Arne (2004) in her study in Butajira found that poisoning with agrochemicals is not believed to be a major health problem, compared to other types of injuries or diseases, for farmers.

**Photo 8-1: Aphid treatment, Grass peas (Guaya), Lake Tana area, Jan. 2009**



The standard crop packages include recommendations for use of pesticides. Woreda and kebele Development Agents promote the packages and deliver some training to farmers through the Farmer Training Centres (Photo 8-2). Consequently farmers in the command area are aware that pesticides are poisonous and can have harmful impacts on human beings, animals and the environment, and many have some rudimentary knowledge of precautionary measures such as use of protective clothing, safe storage, cleaning of spray equipment, washing after completing spraying activities, and observing re-entry periods. However this knowledge is seldom implemented effectively in practice.

**Photo 8-2: Farmer Training Centre, Kaha, Megech Command Area, 2010**



A significant factor that will constrain uptake of IPM practices is the attitude that pesticides are modern "medicines" that can cure all the problems affecting a crop, and the belief that there are no proven alternatives.

## 8.2.3 Regulatory and Institutional Framework

### 8.2.3.1 Policy, Laws and Regulations

In accordance with the UN Millennium Development Goals, the Government of Ethiopia is committed to achieving food security and reducing poverty by the year 2015 (MoFED 2006). Ethiopia's chances of success in this endeavour are largely dependent on its agricultural development. To this effect, the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) is being implemented (MARD 2006). This strategy envisages a several-fold increase in productivity, production and export volumes of both crops and livestock.

As was stated in Azerefegne & Abate (2007), a detailed review of pesticide regulation in Ethiopia can be found in Gordon *et al* (1995) and Abate & Fenta (2003). Ethiopia enacted its pesticide regulation in 1990. Pesticide Regulation and Control Council of State Special Decree No. 20/1990 prohibits the manufacture, import, sale or use of any pesticide not registered in accordance with the decree. The Pesticide Registration Council of Ethiopia has registered a total of 177 pesticides consisting of 108 insecticides, 55 herbicides, and 19 fungicides (Annex 3).

Under the Decree, a National Pesticide Advisory Committee has been established to advise MARD on implementation of the decree.

The plant quarantine service started its operation based on the 1971 Plant Protection Degree No 56/1971, followed by Plant Quarantine Regulation No. 4/1992 which authorises MARD to control the movement of plants and plant products within Ethiopia, with the aim of avoiding the introduction of exotic plant pests.

Quality control is the responsibility of the Quality and Standards Agency of Ethiopia (QSAE). The MARD pesticides laboratory at Sholla, Addis Ababa, has some capacity for checking pesticides, but in general the ability to regulate pesticides in Ethiopia is limited by inadequate laboratory facilities and both human and material resources. The capability to analyse residues is an essential component of pesticide regulation because it enables a regulatory agency to determine if pesticide residues in agricultural and animal products are within the levels (or pesticide tolerances) allowed in the country (Azerefegne & Abate 2007). Ethiopia has adopted the tolerances established by WHO/FAO, but there is no way to enforce them (Gordon *et al.* 1995).

There is no separate policy on IPM in Ethiopia or any developed IPM implementation strategy. Similarly there is nor formal policy on organic agriculture or the development, quality control and marketing of organic produce. However, according to Azerefegne & Abate (2007) a draft crop protection policy that emphasises IPM as a preferred approach to pest management has been prepared. The draft document is incorporated in the National Agriculture Policy, which has not been implemented up to now. In addition, a draft regulation on the import and release of biological control agents for the control of pests has been developed and awaits approval for its implementation.

Ethiopia is a signatory to the Stockholm Convention on Persistent Organic Pollutants (POPs), and has established this in domestic law through Proclamation 279/2002.

### 8.2.3.2 Institutions

MoARD's Animal and Plant Health Directorate plays a major role in the import and distribution of pesticides in the country, and also provides training to staff working in plant health clinics (PHCs) around the country. In turn, the staff members of the plant health clinics are involved in training of field extension workers and farmers. This directorate has the usual structure, with units at regional, zonal and woreda level. However, due to lack of facilities, trained personnel and funds, inspection tasks such as checking on package, labelling, test for quality and residue in plant parts, animals and soils are not taking place as expected.

Local distribution of pesticides is carried out by the Agricultural Inputs Supply Corporation (AISCO) and by cooperative organisations located in the regional, zonal and woreda headquarter towns (Kola Diba). There is little official private sector distribution of pesticides, but significant informal activity.

Pest management advice is mainly delivered through the extension system run by MARD and the BoARD. Crop protection experts from the national agricultural research system and higher learning institutions can provide advice to farmers around their study area, but at present this does not include the Dembia Plain where the MPIDP is situated. Research tends to focus on single pest issues, rather than taking the holistic approach necessary for effective IPM.

The Crop Protection Society of Ethiopia provides advice by organising an annual conference, the publication of journals, proceedings and leaflets etc.

## 8.2.4 Experience with IPM

### 8.2.4.1 IPM

Integrated Pest Management (IPM) refers to a mix of farmer-driven, ecologically based pest control practices that seeks to reduce reliance on synthetic chemical pesticides. It involves (a) managing pests (keeping them below economically damaging levels) rather than seeking to eradicate them; (b) relying, to the extent possible, on nonchemical measures to keep pest populations low; and (c) selecting and applying pesticides, when they have to be used, in a way that minimises adverse effects on beneficial organisms, humans, and the environment.

As noted in den Belder & Elings (2007), IPM techniques can be separated into two major groups: (i) relatively straightforward replacements for chemicals, and (ii) supporting measures. Chemical replacements include:

**Biological control:** the introduction of insects, mites, micro-organisms that prey on or parasitise harmful species.

**Biopesticides:** these have a pathogenic micro-organism as the active ingredient, for example a bacterium or a virus (for example, Bt).

**Botanicals:** botanical pesticides contain plant extracts that have biocidal properties (for example, neem).

**Semiochemicals:** chemicals (especially pheromones) are used to stimulate particular behaviours or interactions between individual insects so as to control pests.

Choosing appropriate measures is not straightforward and requires significant understanding of the interactions between environment, crop, pest and predator. The scientific basis for farmer decision making in biological control depends on detailed knowledge of the life histories of pests and their natural enemies, crop ecology, and interactions within the agro-ecosystem. Farmer participation and learning are essential.

Supporting measures include traditional methods of pest control as used in subsistence farming systems: cultural control (e.g., intercropping), habitat manipulation (e.g., creating diversity), mechanical and physical control, natural biological systems, and host plant resistance.

### 8.2.4.2 National Experience with IPM

Abate (2006) states that "a fair amount of knowledge exists on IPM of several crop pests in Ethiopia. Some of it has already been put into practical use, some studies are currently ongoing, and a lot remains to be done in the times ahead. The focus appears to be on migratory insect pests such as the African armyworm (*Spodoptera exempta*), the African migratory locust (*Locusta migratoria migratoroides*) and the desert locust (*Schistocerca gregaria*) and on a number of regular (non-migratory) insect pests in open-field crops. It appears that a renewed effort is required, with more attention for insect pests of relevance to protected cultivation".

There is significant interest in the application of IPM to the rapidly-expanding floriculture industry, which is beset by spider mites and in which agrochemicals, mainly pesticides, comprise 24% of the cut-flower value chain (den Belder & Elings 2007).

As topics, IPM and extension methods continue to attract Ethiopian agricultural research students (see, for example, Babur Damtie Endalew 2009).

### 8.2.4.3 Local Experience with IPM

As noted by Azerefegne & Abate (2007), some successful IPM projects have been implemented by the BoARD, the research system and NGOs. An IPM working group was established in the Amhara Region comprising experts from Amhara Regional Agricultural Research Institute (ARARI), BoARD, the Bahir Dar and Kombolcha Plant Health Clinics and Save the Children (SC-UK) as members. The experts regularly met and planned IPM activities to be implemented with farmers.

The group performed activities including training of crop protection staff, development agents and farmers on various aspects of IPM. Pilot projects on the management of Wollo bush cricket (*Decticoidea brevipennis*, locally *Degezsa*) and sorghum chafer grub (*Pachnoda interrupta*) were tried, using mechanical means (e.g. hand picking, making trenches, etc.), sanitation, and pesticide baiting or spraying on trap crops. The most important accomplishment was a reduction in the demand for pesticides from farmers to control these pests (Azerefegne & Abate 2007).

Continuation of the group's work depended on external funding, and it is now non-functional.



## 8.3 FUTURE SITUATION WITH AND WITHOUT MITIGATION

### 8.3.1 Feasibility Study Proposals for Pest Management

The purpose of MPIDP and RIDP is to intensify and commercialise small-scale agriculture. Almost invariably such increases in production are associated with increased external inputs, including agrochemicals. As stated in the MPIDP Feasibility Study "More intensive cropping raises the level of foliar and soil-borne pest populations, requiring more systematic crop protection and use of pesticides."

In response to these requirements, the Feasibility Study (Chapter C, Section 1.9.1) states that "Pest control will rely on the formulation of IPM principles ..." and that "Advisers will train growers in pest scouting and control practices, emphasising environmentally friendly practices." Furthermore, "Crop protection extension specialists will be needed, together with the involvement of a plant clinic operated by university or research stations (*sic*) to identify pests." Coordination of extension, research, training, demonstrations and site-specific know-how will be carried out by "... an agricultural services and training centre established under the project ...", and (Chapter C, Section 1.9.4) "Recommendations regarding chemical application will be determined by the extension services."

The Feasibility Study goes on to describe a proposed comprehensive extension-advisory system including regional and project-level extension specialists; researchers; internationally-trained trainers; regional field advisors with offices, communications and field equipment, "modern extension practices" including model farms, crop monitoring, field days, in-field verbal extension, written recommendations, and "educated and centralised pest control"; field trials and applied agricultural research; a monitoring and evaluation programme; and "full-fledged field extension activities" for producers.

The Feasibility Study does not provide any detailed description of this comprehensive organisation or its funding, and does not provide any further information on IPM or pest management.

### 8.3.2 Impact Scenarios

In practice, the present system for control and application of pesticides in Ethiopia is weak and only partially regulated. In the absence of the comprehensive extension organisation and high-knowledge environment described in the Feasibility Study, the project is almost certain to result in a significant increase in inefficient or ineffective pest control practices, including increased improper use and disposal of pesticides. Of most concern is the likelihood of increased unregulated use of insecticides on commercial crops, especially vegetables and rice. Pest are regarded by farmers to be the most important limiting factor for crops in the moister areas near the lake, especially cutworm (Akalu Teshome *et al.* 2009). In addition, there is a possibility of increased levels of herbicide application for weed control.

For example, recommendations for crop pest management given in the recent detailed ARARI report on agricultural potentials, constraints and opportunities in the Megech and Ribb areas (Akalu Teshome *et al.* 2009) include:

Cutworm: irrigate fields two days before application to drive larvae close to the surface, then apply carbaryl, chlorpyrifos or trichlorfon (at present malathion is used).

Aphids on pulses: spray aphicides (dimethoate, pirimicarb, pirimiphos-methyl) just before flowering and again at pod stage.

Other requirements for pest control include the removal of potential host plants from around fields, which will contribute to the sterilisation of the landscape and loss of beneficial insects and predators.

### 8.3.3 Risks

Increased use of pesticides without associated major improvements in knowledge, attitude and practice in chemical application, equipment, storage and container disposal will:

Increase existing hazards and risks, both of occupational exposure (farmers, sprayers) and local residents.

In addition, drift and runoff will rapidly enter the aquatic environment which is closely linked to Lake Tana, with potentially significant consequences for aquatic wildlife and the associated food chain (e.g. fish, protected migratory birds) through both direct toxicity and bio-accumulation.

Impacts on bees and other pollinators will increase further, since some of the chemicals now in use or recommended (e.g. carbaryl, chlorpyrifos) are highly toxic to honeybees<sup>2</sup>.

This matches concerns at national level, summarised by Azerefegne and Abate (2007) as:

"Pesticides/active ingredients causing most concern include organochlorines such as endosulfan and pyrethroids (such as deltamethrin, cypermethrin, etc.). Concerns from pesticide arise from three major areas. These are environmental, toxicological and economic (possibility of products being rejected due to residues). Persistent pesticides such as endosulfan belong to the chlorinated hydrocarbons and are cause for concern both in terms of the environment as well as their residue on crops. Many of the organophosphates and pyrethroids have high levels of toxicity (mostly in WHO class II category). In addition, pyrethroids are broad spectrum pesticides and as such kill all organisms including natural enemies and therefore can cause secondary outbreaks, as has been noticed in the outbreak of red spider mites in onions in the Awash valley."

### 8.3.4 Compliance of Project with IPM Principles

The MPIDP Feasibility Study proposes pest management in accordance with IPM principles, but without providing practical details of the large, skilled extension and research service necessary to ensure this.

Therefore further development of the project's pest management proposals is necessary to develop implementable, sustainable solutions and reduce the risks to acceptable levels.

### 8.3.5 To Move Towards IPM

#### 8.3.5.1 Objectives

##### General Objectives

Ensure the project develops and implements an IPM approach, including biological control, appropriate cultural practices and the development and use of crop varieties that are resistant or tolerant to pests (WB OP.4.09).

Develop and implement a holistic IPM approach as discussed in den Belder & Elings (2007), in which multiple practices are implemented throughout the entire production period.

##### Specific Objectives

Develop a Phase 2 PMP.

Embed the Phase 2 PMP in the project as a key component of (i) its conceptual approach to commercialisation of smallholder agriculture, and (ii) as a practical element affecting all aspects of extension and training.

Establish an IPM delivery system, from research through to the farmer.

Implement participatory approaches in IPM for farmers to learn, test, select and implement IPM options to reduce losses due to pests and diseases.

Establish a monitoring system that provides early warning on pest status, beneficial species, regular and migratory pests.

Collaborate with other IPM programmes to develop national IPM policy.

#### 8.3.5.2 Capacity Building for IPM

Implementation of an IPM approach in line with Bank policy - and as required on both occupational health and environmental grounds - will require a major increase in capacity at several levels:

Research: to develop measures which are economically effective under command area physical, ecological and social conditions.

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<sup>2</sup> See <http://www.beesfordevelopment.org/info/info/pesticides/bees-pesticides.shtml>

Delivery: training of trainers in IPM.

Farmers: to understand and apply IPM.

Monitoring: to provide the advance warning of pest build-ups required for management, and to verify control measures, as well as to measure the performance of the IPM capacity building activities themselves.

Key players in this system will be BoARD, ARARI, the regional plant health clinics, and WoARD staff, together with support from parent or parallel organisations at national level (MoARD and other elements of the agricultural research and training system). The Bureau of Health should be a participant. There should also be a link to markets, especially if a line of organic products is developed. NGOs may have a role, but whilst useful for temporary support they tend not to provide institutional sustainability; IPM requires long-term application, given the fragility of the Lake Tana ecosystem and the development pressures rapidly building. Under the project (MPIDP) the organisational framework for this is provided by ENIDP Component 2.

### **8.3.5.3 Possible Activities and Development of Phase 2 PMP**

Table 6 presents a draft planning matrix for development and implementation of IPM within the MPIDP, as the basis for discussion during development of the Phase 2 PMP.

Similarly, Table 7 presents an outline of activities, expected results, milestones and performance indicators involved in and expected from implementation of the PMP.

The recommended next stage is development of a Phase 2 PMP through:

Consultation with stakeholders, primarily MoARD/BoARD, ARARI, MoWR and the World Bank.

Elaboration of the Phase 2 PMP (organisational details, firm budgets etc).

Second round of consultation.

Finalisation of PMP document.

This will require the services of an experienced IPM specialist to act as both principal technical resource person and facilitator. National expertise is available, but international expertise is recommended as well to provide the in-depth IPM experience, international contacts and understanding of project preparation required for smooth integration of this major activity into existing plans for project delivery.

Outline TOR for the development of a Phase 2 PMP are attached at Annex 12 of this volume of the ESIA report, together with an indicative budget.

**Table 8-6 Draft Planning Matrix, for development during Phase 2**

Narrative Summary	Expected Results	Performance Indicators	Assumption/Risks
<p>Goal</p> <p>Empower crop and livestock farmers to protect their health and the environment and contribute significantly to household economies through environmentally friendly pest management practices</p>	<p>Food security enhanced, environmental quality improved crop and livestock productivity and farmers' income increased</p>	<p>Evidence of improvements in food availability, level of poverty and environmental protection in MPIDP, and lack of health impacts (poisoning)</p>	<p>Project effectively builds IPM capacity and delivers appropriate training, inputs and information</p>
<p>Purpose</p> <p>1. In the immediate future halt and reverse losses caused by pests in order to increase profitability of project area agriculture</p> <p>2. In the longer term strengthen national and local capacity to reduce environmental and health risks associated with pest management practices in the MPIDP and RIDP</p>	<p>Medium-term results/outcomes</p> <p>Farmers in MPIDP identify IPM opportunities to mitigate negative environmental and social impacts associated with pesticides</p> <p>Farmers in MPIDP and RIDP adopt ecologically sound options to reduce crop and livestock losses with minimal personal and environmental health risks</p> <p>MPIDP and RIDP decision makers provided with clearer guidelines enabling them to promote IPM approaches and options in project area agriculture</p> <p>Collaborative linkages established to develop a national IPM policy</p>	<p>Availability of sufficient food</p> <p>Perception of state agencies regarding the value of IPM in MPIDP &amp; RIDP agriculture</p> <p>Level of compliance with World Bank policies etc.</p> <p>Level of chemical control practices</p> <p>Types and level of use of alternatives to synthetic pesticides</p>	

**Table 8-7 Components, Activities and Expected Results of PMP**

Activities	Expected Results	Milestones	Performance Indicators	Assumptions/Risks
<p>1. Record stakeholders' views on crop and livestock pests.</p> <p>2. Conduct field diagnosis to specify pests that affect MPIDP and RIDP</p> <p>3. Identify farmers' coping mechanisms and researcher recommended IPM options.</p> <p>4. Develop and explain historical profile of pesticide use and other pest control practices in the MPIDP and RIDP command area.</p> <p>5. Specify partnership opportunities at local, national and international levels to assist in implementation of the PMP.</p>	<p>Result 1: Members of MPIDP and RIDP and other relevant stakeholder group develop common understanding of key pest problems and agree on corrective action.</p>	<ul style="list-style-type: none"> <li>✓ Pest problems diagnosed and related IPM opportunities identified.</li> <li>✓ Potential constraints farmers may face in the use of the technologies specified.</li> <li>✓ Pest lists including quarantine pests and alien invasive species developed.</li> <li>✓ Potential for improving existing pest control practices assessed.</li> <li>✓ Pest monitoring schemes for early Warning on alien invasive species and migratory pests are organized and functional action plan for location-specific IPM activities developed.</li> <li>✓ PMP implementation mechanism developed by neighbouring areas.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Type and nature of participatory methods for problem analysis</li> <li>✓ Documented information on the status of pests and natural enemies of pest and pollinators in MPIDP and RIDP</li> <li>✓ Inventory of alien invasive species and quarantine pests</li> <li>✓ Types and availability of natural enemies for use in biological control of named pest</li> <li>✓ Types and availability of botanical pesticides to replace chemical pesticides</li> <li>✓ Typed and number of crop rotation schemes to reduce build up of named pest species</li> <li>✓ Type of composting and mulching as alternatives to mineral fertilisers</li> <li>✓ List of principal actors and of partners</li> </ul>	<p>Social, economic and political situations remain stable</p>

Activities	Expected Results	Milestones	Performance Indicators	Assumptions/Risks
<ol style="list-style-type: none"> <li>1. Develop participatory methods in line with farmers identified training needs</li> <li>2. Conduct short to medium term training of farmer support groups on skills relevant to their needs</li> <li>3. Intensify training of men and women farmers in IPM knowledge and skills</li> <li>4. Promote farmer-led extension to increase secondary adoption of proven IPM options</li> <li>5. Strengthen researcher-farmer-extension linkages through participatory research on issues emerging from farmer training</li> <li>6. Develop/disseminate IPM decision – support information resources for field agents, farmers policy makers and the general public</li> </ol>	<p>Result 2: Human resource capacity for IPM delivery and implementation developed</p>	<p>One IPM orientation workshop per group of 30 in Yrs 1 &amp; 2</p> <p>Crop/livestock and pest management practices developed and adapted to suit local needs</p> <p>Farmers accurately relate pests to respective damage symptoms: recognise natural enemies/ biological control agents against the pests; test a range of IPM options and select “best-bet” options to implement and adopt.</p>	<ul style="list-style-type: none"> <li>✓ Types of IPM skills covered in visits by agric. staff</li> <li>✓ Number of farmers’ learning groups implemented</li> <li>✓ Gender and number of extension agents and of farmers trained</li> <li>✓ Gender and number of trained farmers engaged in participatory extension</li> <li>✓ Extent to which new knowledge/skills are used by extension agents &amp; farmers to promote adoption of IPM options</li> <li>✓ Number &amp; type of IPM information materials developed/ disseminated</li> <li>✓ Number and type of new IPM options introduced and adopted</li> <li>✓ Gender and number of farmer adopting IPM technologies</li> <li>✓ Area of crops under IPM</li> <li>✓ Incremental benefits due to pest control</li> <li>✓ Types and number of user-friendly taxonomic keys for pest and natural enemy recognition by farmers</li> </ul>	<p>Farmers adopt and apply new improved technologies</p> <p>MPIDP and RIDP users and their service providers comply with international conventions guiding pesticide use</p> <p>Critical mass of staff trained remain with in the MPIDP and RIDP communities</p>

#### 8.3.5.4 Authorised Pesticides

Unless the project switches to and enforces an organic approach, it is inevitable that pesticides will be recommended for use on some of the crops to be grown. Depending on the exact mechanics of World Bank funding for ENIDP Component 2, consideration may have to be given to the development of a provisional list of pesticides that could be funded by credit provided under the project

This is a matter to be decided during development of the Phase 2 PMP.

#### 8.3.5.5 Monitoring and Evaluation

As discussed in Youdeowei (2002), successful implementation of a PMP requires regular monitoring and evaluation (M&E) of activities undertaken by farmers in the project area. The focus of M&E must be to assess the build up of IPM capacity in the command area, the extent to which IPM techniques are being adopted in crop production, and the economic benefits that farmers derive by adopting IPM.

Activities that require regular monitoring and evaluation during implementation are:

IPM capacity building for farmers in the project area: number of farmers who have successfully received IPM training in IPM methods; evaluate the training content, methodology and trainee response to training through feedback.

Number of farmers who have adopted IPM practices as a crop protection strategy in their crop production efforts: evaluate the rate of IPM adoption.

In how many crop production systems is IPM applied? Are the numbers increasing and at what rate?

Activities that require M&E during supervision visits:

What are major benefits that farmers derive by adopting IPM (economic and social benefits)?

To what extent are pesticides used for crop production?

Efficiency and safety of pesticide use and handling.

Level of reduction of pesticide purchase and use by farmers for crop protection, compared with a baseline established before project implementation.

Efficient monitoring requires regular observation on a weekly basis, if not more frequent. Visual inspections must be made at field level for pests such as stalk borers, cutworms, disease symptoms and weeds, and their natural enemies. These practices allow farmers to apply crop management measures early, thus preventing serious and persistent crop damage.

#### 8.3.5.6 Indicative Budgets

**Phase 2 PMP development:** preparation of the Phase 2 PMP will take a minimum of 1 month of professional time. It will involve several rounds of consultation and associated workshops, and a some travel between Addis Ababa and Bahir Dar. The budget should therefore be set at USD 20-40,000, depending on the level of international support commissioned. An indicative budget (Annex 12.2) estimates costs at around USD 33,000.

**PMP Implementation:** the costs of PMP implementation will depend on the scale and details of the programme eventually agreed. Indicative costs for typical activities are given in Table 8, using Ethiopian norms. These total only some USD 26,000 over five years. However, to these indicative costs must be added the significant costs for:

- development of IPM research capacity (training, equipment),
- IPM research itself (operational costs, transport),
- development of IPM delivery capacity (as a major component of the agricultural extension service strengthening that will be needed for the project: training, facilities and equipment (major upgrades of the existing Farmer Training Centres), transport)),
- operational costs of IPM delivery to farmers (e.g. vehicles, fuel, training materials), and
- any technical assistance required to build the required capacity.

Considering the potential importance of IPM to achieving project goals and to ensuring the sustainability of the sensitive Lake Tana ecosystem, it is suggested that it would not be unreasonable to devote 0.5 to 1.0% of total project costs to this topic.

**Table 8-8: Indicative Costs of Typical PMP Activities in the Field (ETB)**

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Capacity building IPM orientation workshops	32,880	16,440				49,320
Training of trainers	71,500					71,500
Farmer group training	18,400	18,400	18,400	18,400	18,400	92,000
Advisory services						
IPM problem diagnosis	10,000	8,000	6,000	10,000		24,000
Field guides/IPM materials	20,000	15,000	10,000			55,000
Public awareness	7,000	5,000	3,000			15,000
Project management	5,000	3,000	2,000	1,000	1,000	12,000
PMP coordination monitoring & evaluation	10,000	8,000	8,000	6,000	6,000	38,000
<b>Total</b>	<b>174,780</b>	<b>73,840</b>	<b>47,400</b>	<b>35,400</b>	<b>25,400</b>	<b>356,820</b>

**Notes**

1. IPM orientation: 6 workshops for 300 Regional, Zonal & Woreda staff
2. Training of trainers: 1 TOT course for 30 participants for 15 days
3. Farmers group training: 25 farmers trained for two weeks, 200 farmers trained each year
4. IPM problem diagnosis for three years at total cost of ETB 24,000
5. Field guides: cost of preparing and producing field guides: ETB 55,000 over four years
6. Public awareness campaigns for radio and posters: ETB 5,000 per year for 3 years
7. PMP coordination for supervision visit: cost ETB 12,000 over 5 years



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## 8.5 APPENDIX 1: PERSONS AND ORGANISATIONS CONTACTED

Name	Position / Affiliation	Contact
<b>ADDIS ABABA</b>		
Fekerea Markos	MoARD: Deputy Head of Animal & Plant Health Regulatory Directorate	-
W/o Saba Debebe	MoARD: Pesticide Registration Officer	0911886530
Gezachew Asefa	Senior Expert, MoARD Animal and Plant Quarantine Directorate Office	-
Akililu Kebede	Senior Expert – Ethiopian Wildlife Conservation Authority	-
<b>BAHIR DAR</b>		
Tenaw Ejigu	BoARD - Irrigation and Drainage Process Owner	0918705114
Bitew Melese	BoARD - Agricultural Extension Service Process Owner	0918719789
Tesfaye Mengestu	BoARD - Former Head of Extension	0582205850
Alehegne Dagneu	BoARD - Coordinator for Irrigation and Drainage Projects - Watershed Management	0918707256
Ayehew Zerihun	Head, Plant Health Clinic	0918013093
Dr. Nuria Yideg	Head, Animal Health Laboratory	0918761186
Berhanu Yiachew	ENIDP Coordination Office Monitoring & Evaluation Specialist	0918761428
Fantahun Turuneh (Dr.)	Head of ARARI	-
Dr. Birru Yitferu	ARARI: Director of Soil and Water Research	0582207153
Dr. Gizaw Desta	ARARI: Senior Researcher	0912860328
Yitayal Abebe	BoEPLAU: Environmental Protection Process Owner	0918707172
Mehretu Dagneu	BoEPLAU: Land Evaluation and Resettlement Alternative Preparation Expert	-
Abdurahman Mohamed	BoEPLAU	-
Asmare Mekonen	BoEPLAU	-
<b>DEMBIA WOREDA</b>		
Alemeh Benti	Secretary, Woreda Administration office	
Teshager Meles	WoARD: Irrigation & Drainage Expert	
Sebsebachew Atnafu	Land Use Planning: Expert	
Yesheharg Tewab	Head, Women's Affairs office	
Kelemwork Tezera	Head, Water Resources office	
Setotaw Begashaw	Head, Health office	
Getahun Mohammed	Head, Finance and Economics office	
<b>FOGERA WOREDA</b>		
Yalew Zenawe	Woreda Administration office	
Worku Mulate	Head, Woreda Agricultural and Rural Development office (WoARD)	0918702671/0305
Nugusea Asefa	WoARD: Agronomist	0584460064
Melese Dametea	WoARD: Planning Expert	0918713409
Agmasea Alamnew	WoARD: Cooperative Process Owner	
Abayneh Gelaw	WoARD: Cooperative Expert	0918214116
Feseha Alemu	WoARD:	0918063288
Hailea Berara	WoARD: Extension Expert	0912334938

Name	Position / Affiliation	Contact
Beyadeg Woube	WoARD: Irrigation & Drainage Coordinator	0918091169
Habtea W/Selasea	WoARD: Irrigation Expert	0918097417
Getachew Mola	WoARD: Natural Resources Expert	0918073395
Ayalneh Mulate	WoARD: Marketing Expert	0911362315
Balemale Adane	Woreda Water Resource office: Expert	0918700396
Worku Melese	Woreda Health office: Expert	0918702608
<b>LIBO KEMKEM WOREDA</b>		
Fentanesh Tefera	Woreda Administration office	0584440035
Adesu Tefera	Head, Woreda Agriculture and Rural Development office (WoARD)	0918700305
W/t Begosera Tadess	WoARD: Irrigation Agronomist	0584440024
Yared Tegabu	WoARD: Extension Expert	0918208050
Habtamu Yemer	Land Administration office: Coordinator	0584440036
Egal Deres	Food security office: Coordinator	0584440872
Meheret Aynew	Cooperatives office: Monitoring & Evaluation	0584440871
W/ro Muluken Berhanu	Women's Affairs office: Head	0918710952
Nega Bekel	Woreda Health office: Acting Head	0918040962
Germa Tayachew	Woreda Education office: Acting Head	0918710774

## 8.6 APPENDIX 2: ITINERARY

### 8.6.1 Megech Pump (Seraba) Irrigation and Drainage Project

Date	Departure	Arrival	Activities	Overnight
4/10/2009	Addis Abeba	Bahir-Dar	Travel	Bahir-Dar
5/04/2009	Bahir-Dar	Koladiba	Conducted meeting with the Woreda office of Agriculture and Rural Development Visit Gorgora,	Gondar
6/04/2009	Gondar	Koladiba	Conducted meeting with concerned institutions and Field visit	Gondar
7/04/2009	Gondar	Koladiba	Visited MPIDP command area and conducted discussions with the beneficiaries	Gondar
8/04/2009	Gondar	Koladiba	Continued the field visit	Gondar
9/04/2009	Gondar	Bahir-Dar	Met BoARD, BoEPLAU, ARARI and discussed the issues	Bahir-Dar
10/04/2009	Bahir-Dar	Addis Abeba	Travel	

## 8.6.2 Ribb Irrigation and Drainage Project

Date	Departure	Arrival	Activities	Overnight
12/04/2010	Addis Abeba	Bahir- Dar	Travel	Bahir-Dar
13/04/2010	Bahir-Dar	Woreta	Met ANRS Bureau of Agriculture and Rural Development irrigation development process owner, Arranged a meeting with Amhara Regional Agricultural Research Institute with the project focal person, Amhara Bureau of Finance and Economic Development, the project focal person, and with Fogera and Libo Kemkem woreda offices of Agriculture and Rural Development to arrange meetings in the consecutive days.	Woreta
14/04/2010	Woreta	Woreta	Met the Fogera woreda concerned sector office representatives and visit the command area within the woreda.	Woreta
15/04/2010	Woreta	Addis Zemen	Met the Libo Kemkem woreda concerned sector office representatives and visited the irrigation dam site and the command area within the woreda.	Woreta
16/04/2010	Woreta	Bahir-Dar	Conducted meeting with ARARI, Director of soil and water conservation directorate and with Ethiopian Nile Irrigation and Drainage Project coordinator office. Contacted BoEPLAU.	Woreta
17/04/2010	Woreta	Woreta	Visited Libo Kemkem command area, Burra Egzearebe kebele and discuss the issues with the administrator of the kebele	Woreta
18/04/2010	Woreta	Bahir-Dar	Visited Fogera command area, Ribb Gabriel Kebele and discuss the issues with the farmers	Bahir-Dar
19/04/2010	Bahir-Dar	Addis Abeba	Travel	

## 8.7 APPENDIX 3: LISTS OF BANNED AND REGISTERED PESTICIDES

### 8.7.1 Banned Pesticides

It is understood that the following pesticides have been banned in Ethiopia:

- Aldrin
- Dieldrin
- DDT
- Heptachlor
- Zinc phosphide

### 8.7.2 Registered Pesticides, April 2010

Note: the following lists have been re-formatted by BRLi for clarity, with no alteration to content.

**MINISTRY OF AGRICULTURE AND RURAL  
DEVELOPMENT**

**Animal and Plant Health Regulatory Directorate**

**List of Registered Pesticides as of April 2010**

**April 2010**

**8.7.2.1 List of Registered Pesticides (Insecticides)**

REGISTERED INSECTICIDES				
No	Trade Name	Common Name	Approved Uses	Registrant
1	ACE 750 SP	Acephate	For the control of aphids, thrips and caterpillars on flowers.	27
2	Actara 25 WG	Thiamethoxam 250g/kg	For the control of aphids, white fly & caterpillar on flowers.	6
3	Actellic 2% dust*	Pirimiphos-methyl	For the control of storage pests on cereals and pulses.	6
4	Actellic 50 EC*	Pirimiphos methyl	For the control of aphids in cotton.	6
5	Actellic 50 EC	Pirimiphos methyl 50% EC	For the control of mosquitoes ( <i>Anopheles arabiensis</i> ).	6
6	Adonis 12.5 UL*	fipronil 12.5% ULV	For the control of locusts.	3
7	Agro-Thoate 40% EC*	Dimethoate 40% EC	1. For the control of beanfly ( <i>Ophiomyia phaseoli</i> ); Bean aphid ( <i>Aphis fabae</i> ); Thrips ( <i>Taenothrips spp.</i> ) ABW ( <i>Helicoverpa armigera</i> ) on french beans. 2. For the control of aphids ( <i>Myzus persicae</i> ) and ABW ( <i>Helicoverpa armigera</i> ) on tomato. 3. For the control of cabbage Aphid and various aphids on cabbage and potato, respectively.	9
8	Akito 2.5% EC	Beta cypermethrin	For the control of stalk borer on Maize	5
9	Alphahock 7.5% ULV	Alphacypermethrin 7.5% ULV	For the control of sweet potato butterfly on sweet potato	5
10	Alphos 56% Tab.	Aluminium Phosphide 560 gm/kg	Insecticide (Fumigant) for the control of maize weevil on maize.	33
11	Apron Star 42 WS	thiamethoxam 20% + metalaxyl - 20% + difenoconazole 2%	For the control of Russian wheat aphid on barley (To be used as seed treatment pesticide)	6
12	Basudin 600 EW*	diazinon	For the control of armyworm and other pests on cereals.	6
13	Baythroid 050 EC*	cyfluthrin	For the control of shoot fly, aphids, fleas and stock borer on sorghum.	11
14	Bestox 7.5 ULV*	alphacypermethrin	For the control of African bollworm on cotton.	3
15	Celphos	Aluminium phosphide 56% table	for the control of maize weevil ( <i>sitophilus spp</i> ) and flour beetle ( <i>Tribolium spp</i> ) on stored maize.	24
16	Cruiser 70 WS	thiamethoxam 70% WS	For the control of Russian wheat aphid on barley (To be used as seed treatment pesticide).	6
17	Confidor SL 200	Imidacloprid 200 gm/lit	For the control of Aphids, thrips whitefly & termites on flowers.	4
18	Cruiser 350 FS	thiamethoxam 35% FS	For the control of Russian wheat aphid on barley (To be used as seed treatment pesticide).	6
19	Cybolt 2.5 ULV*	flucythrinate 2.5% ULV	For the control of whitefly in cotton.	3
20	Curacron 250 EC/ULV**	Profenofos	For the control of white fly on cotton.	6
21	Cymbush 1% Granule****	Cypermethrin	For the control of stalk borer in maize and sorghum	6
22	Cymbush 25% EC***	Cypermethrin	For the control of cotton pests on large scale farms	6
23	Danitol 10% EC	Fenopropathrin	For the control of African bollworm on cotton	1
24	Deltacal 0.2DP*	deltamethrin 0.2%DP	For the control of maize weevil on stored maize	12

REGISTERED INSECTICIDES				
No	Trade Name	Common Name	Approved Uses	Registrant
25	Deltahock 0.6% ULV	Deltamethrin 0.6% ULV	For the control of sweet potato butterfly on sweet potato	5
26	Decis 0.5 EC/ULV*	Deltamethrin	For the control of African bollworm and leafhoppers on cotton	4
27	Decis 0.6 ULV*	Deltamethrin	For the control of African bollworm and leafhoppers on cotton	4
28	Decis 2.5 EC*	Deltamethrin	For the control of African bollworm and leafhoppers on cotton.	4
29	Decis EC 025	Deltamethrin 25 gm/lit	For the control of aphids, thrips & caterpillar on flowers.	4
30	Delicia *	aluminium phosphide 56.7%	For the control of storage pests on cereals and pulses.	15
31	Deltanet 200 EC*	Furathiocarb	For the control of aphids on cotton	6
32	Detia Gas-Ex- T*	aluminium phosphide 56.7%	For the control of storage weevils and beetles on cereals and pulses.	16
33	Devicyprin 25	cypermetrin	For the control of stalk borer on maize	26
34	Diazinon 10%G	Diazinon	For the control of stalk borers on maize and sorghum	7
35	Diazinon 60% EC	Diazinon	For the control of armyworm on cereals	7
36	Diazol 10G*	Diazinon	For the control of stalk borer on maize and sorghum	5
37	Diazol 60 EC*	Diazinon	For the control of pests of cereals, vegetables and oil seeds	5
38	Diptrex SP 95*	trichlorofon 95%	For the control of shootfly on cereals	11
39	Dursban 240 ULV*	chloropyrifos-ethyl	For the control of armyworm, locusts, and grasshoppers on cereals and pastures	2
40	Dursban 48% EC*	chloropyrifos-ethyl	For the control of armyworm, locusts and grasshoppers on cereals and termites.	2
41	Dynamec 1.8 EC	Abamectin 18g/l	For the control of Aphids, thrips & spider mites on flowers.	6
42	Ethiolathion 5% Dust	Malathion	For the control of maize Weevil ( <i>Sitophilus zeamays</i> ) on stored maize	18
43	Ethiozinon 60% EC	Diazinon	For the control of maize stalk borer ( <i>Busseola fusca</i> ) and sweet potato butterfly ( <i>Acraea acerata</i> ) on maize and sweet potato respectively.	18
44	Ethiozinon 60% EC	Diazinon	-For the control of termite damage in hot pepper	18
45	Ethiolation 50% EC	Malathion	For the control of sweet potato butterfly ( <i>Acraea acerata</i> ) on sweet potato	18
46	Ethiotrothion 50% EC	Fenithrothion	For the control of sweet potato butterfly ( <i>Acraea acerata</i> ) on sweet potato	18
47	Ethiosulfan 25% ULV	Endosulfan	For the control of African bollworm ( <i>Helicoverpa armigera</i> ) on cotton	18
48	Ethiothoate 40% E.C	Dimethoate	1. For the control of Aphids on field pea 2. For the control of Russian Wheat Aphid ( <i>Diuraphis Noxia</i> ) on barley	18
49	Fastac 10% EC	Alphacypermetrin	For the control of caterpillar, aphids, thrips & whitefly on flowers.	29
50	Fastac 7.5 g/l ULV*	Alphacypermethrin	For the control of African bollworm in cotton	8
51	Fullongphos	Aluminium phosphide	For the control of maize weevil and other storage pests on stored maize	26
52	Fyfanon 50% EC*	Malathion	For the control of armyworm, locusts and grasshoppers on cereals	5
53	Gastoxin	aluminium phosphide tablet 57%	For the control of maize weevil and other storage pests on stored maize	22

REGISTERED INSECTICIDES				
No	Trade Name	Common Name	Approved Uses	Registrant
54	Gaicho 70 WS	Imidacloprid	For the control of Russian wheat aphid ( <i>diuraphis noxia</i> ) on barley.	11
55	Golan 20% SL	Acetamiprid	For the control of aphids, thrips, leaf minor & flea beetle on flowers.	27
56	Helerat 5% EC	lamda cyhlothrin	For the control of bollworm on cotton.	15
57	Helmathion 50 Ec	malathion 50% EC	1. For the control of Aphids and leaf hoppers on maize 2. For the control of storage insect pests in storage structures	15
58	ICONET (Icon 2.5 EC)	Lambda-cyhalothrin 2.5 CS	For the control of mosquitoes ( <i>Anopheles arabiensis</i> ) as a bed net impregnation	6
59	ICON 10 WP	Lambda - cyhalothrin	For the control of mosquitoes ( <i>Anopheles arabiensis</i> )	6
60	K-O Tab.*	deltamethrin 25% m/m	for the control of mosquitoes as a bed net impregnation	8
61	K-Othrine Moustiquare* SC 1%	deltamethrin 1%	For the control of mosquitoes as a bed nets impregnation	8
62	Karate 0.8 ULV*	lambda-cyhalothrin	For the control of cotton pests on large scale farms	6
63	Karate 5 EC*	lambda-cyhalotrin	for the control of cotton pests on large scale farms	6
64				
65	Lamdex 5% EC	Lambda-cyhalothrin 5% EC	For the control of maize stalk borer ( <i>Busseola fusca</i> Fuller)	5
66	Malathion 50% EC*	Malathion	For the control of armyworm, locusts and grasshoppers on cereals and pastures.	1
67	Malt 50% EC	Malathion 500 gm/lt	Insecticide for the control of sweet potato butterfly on sweet potato.	33
68	Marshal 20 UL	Carbosulfan	for the control of locust and grasshoppers	3
69	Marshal 25% EC*	Carbosulfan	for the control of aphids on cotton	3
70	Marshal 25% ULV*	Carbosulfan	for the control of aphids on cotton	3
71	Marshal/Suscon	Carbosulfan	For the control of termites of Eucalyptus trees ( <i>Eucalyptus camaldulensis</i> ; <i>E. citriodora</i> and <i>E. saligna</i> ) and Leucena trees ( <i>Leucena leucocephala</i> )	3
72	Medopaz*	white oil	for the control of red scale ( <i>Aonidiella aurantii</i> ); Orange scale ( <i>Chrysomphalus dictyospermi</i> ); Purple scale ( <i>Chrysomphalus aonidum</i> ) and Black scale ( <i>Parlatoria zizyphus</i> ) on citrus alone or in combination with some organophosphate insecticides	5
73	Metasystox R 250 EC*	oxydemethon-methyl	for the control of shoot fly, aphids, fleas, and stalk borer on sorghum	11
74	Neoron 500 EC*	Bromopropylate	For the control of spider mite on cotton	6
75	Nimbidine	Neem	For the control of thrips on onion	34
76	Nuvacron 40 SCW*	Monocrotofos	For the control of spider mite on cotton.	6
77	Oscar 20% EC	Tebufenpyrad	For the control of Spider mites on flowers.	29
78	Oxymatrin 2.4 SL	Oxymatrin 2.4% SL	For the control of spider mites, aphids, thrips, caterpillar and leafhoppers on flowers.	27
79	Phostoxin 56% Tab.*	aluminium phosphide	For the control of storage pests in warehouses.	2
80	Polo 500 SC	Diafenthiuron 500 SC	For the control of Aphids ( <i>Aphis gossypii</i> ) on cotton	6
81	Polytrin C 220 ULV	profenofos + cypermethrin	For the control of locust and grasshoppers	6



REGISTERED INSECTICIDES				
No	Trade Name	Common Name	Approved Uses	Registrant
82	Polytrin Ka 315 EC/ULV	Profenofos 15 gm/lit + Lambdacyhalothrin 300 gm/lit	For the control of African bollworm on cotton.	6
83	Pyrinex 24 ULV*	chlorophyrifos-ethyl	For the control of armyworm on cereal and pasture	5
84	Pyrinex 48 EC	chloropyrifos-ethyl	For the control of armyworm on cereals and pasture	5
85	Pyrinex	Chlorpyrifos 48% EC	For the control of Termites on hot pepper	5
86	Quickphos*	aluminium phosphide 56% W/W Tablets	For the control of storage pests	5
87	Rimon	Novaluron	IGR to control stalk borer on maize	5
88	Ripcord 5% ULV*	Cypermethrin	For the control of African bollworm, leaf worm and thrips in cotton	3
89	Rufast 75% EW	Acrinathrin	For the control of spider mites, aphids & thrips on flowers.	5
90	SD-Toxin	Aluminium Phosphide	For the control of storage insect pests on maize	30
91	Secure 36% SC	Chlorfenapyr	For the control of red spider mites & caterpillars on flowers.	29
92	Selecron 720 EC*	Profenofos "Q" 720g/l	For the control of maize stalk borer on maize	6
93	Sevin 85% WP*	Carbaryl	For the control of armyworm, grasshoppers Wellobush cricket on cereals & pasture	4
94	Success Bait	Spinosad	For the control of Fruit fly on guava.	2
95	Sumithion 50% EC****	Fenitrothion	For the control of armyworm & locusts on cereals & pastures, Grasshoppers under the supervision of extension agents	1
96	Sumithion 96% ULV*	Fenitrothion	For the control of armyworm and locusts on cereals and pastures	1
97	Sumithion 95% ULV*	Fenitrothion	For the control of armyworm and locusts on cereals and pastures	1
98	Suprathion 40 EC*	methidathion 400 g/l	For the control of scale insects on citrus	5
99	Talstar 20 ULV*	Bifenthrin	For the control of whitefly and red spider mite on cotton	3
100	Thiodan 25% ULV*	Endosulfan	For the control of bollworm on cotton, maize and sorghum	4
101	Thiodan 35% EC*	Endosulfan	For the control of African bollworm on cotton, maize and sorghum.	4
102	Thionex 25% EC/ULV*	endosulfan	For the control of African bollworm on cotton maize, sorghum & tobacco	5
103	Thionex 25% ULV*	Endosulfan	For the control of African bollworm on cotton, maize and sorghum.	5
104	Thionex 35% EC*	Endosulfan	For the control of African bollworm on cotton, maize, sorghum and tobacco.	5
105	Torque 550 SC	Fenbutatin	For the control of Spider mites on flowers.	29
106	Tracer 480 SC	Spinosad (a mixture of spinosyn A & spinosyn B) 480 gm/lit	For the control of thrips and leaf miners on flowers & African bollworm on cotton.	2
107	Ultracide 40 EC*	Methidathion	For the control of scale insects on citrus.	6
108	Winner 0.8 ULV	Lambda cyhalothrin	For the control of African boll worm on cotton.	5

\* Re-registered pesticide.

- \*\* Cancelled from registration upon receipt of a notification, in writing, from the registrant of the pesticide that this specific formulation has been phased out from their production line.
- \*\*\* Cancelled from registration upon receipt of a notification, in writing, from the registrant of the pesticide that it has been withdrawn from sale.
- \*\*\*\* Registration expired.

### 8.7.2.2 List of Registered Pesticides (Herbicides)

REGISTERED HERBICIDES				
No.	Trade Name	Common Name	Approved Uses	Registrant
1	Agroside 72 SL	2,4-D Dimethyl-amine Salt 720g/l	For the control of post emergency annual and perennial broad leaf weeds on wheat.	35
2	Agro-sate 48 SC*	glyphosate 360 g/l A.E	For the control of broad spectrum of weeds in coffee and citrus.	9
3	Agro-amine 2,4-D 720g/l A.E*	2,4-D 720 g/l A.E	For the control of broadleaf weeds in wheat, barley, teff, maize and sorghum	9
4	Alanex 48% EC*	alachlor 480 g/l	For the control of annual grass and some broadleaf weeds in maize and soybeans.	5
5	Alazine 350/200 SE*	alachlor 350 + alazine 200	For the control of grass and some broadleaf weeds in maize	5
6	Ametrazine 500 EC	Atrazine 250 gm/lit + Ametryn 250 gm/lit	Herbicide for the control of annual and perennial grasses and broad leaf weeds in sugar cane.	2
7	Atramet combi 50 SC*	atrazine 25% + ametryne 25%	For the control of grass weeds in sugarcane	5
8	Banvel P	dicamba + mecoprop	For the control of broadleaf weeds in wheat and barley	10
9	Brittox 52.5 EC ****	bromoxynil + ioxynil + mecoprop	For the control of broadleaf weeds in wheat and barley	8
10	Calliherbe Super*	2,4-D 720 g/l A.E	For the control of broadleaf weeds in cereal crops and sugarcane	12
11	Chivad	2,4-D Amine 720 gm/lit SL	For the control of broad leaf weeds on wheat.	28
12	Codal 600 EC**	prometryn + metolachlor	For the control of broadleaf weeds and grass weeds in cotton	6
13	Desormone liquid*	2,4-D 720 g/l A.E	For the control of broadleaf weeds in cereals (wheat, barley, teff, maize & sorghum)	5
14	Derby 175 SC	flurasulam 75 G/L + flumetsulam 100 G/L SC	For the control of broadleaf weeds in cereals	2
15	Dical	2,4-D 720 gm/lit SL	For the control of broad leaf weeds on wheat.	32
16	Dicopur 720 SL*	2,4-D 720 g/l A.E	For the control of broadleaf weeds in cereal crops	5
17	Dicopur 600 SL	Mecoprop 600 G/L Aqueous concentrate	For the control of broad leaf weeds in cereals (wheat, barely and teff)	5
18	Dual Gold 960 EC	s-metolachlor	For the control of broad leaf weeds on haricot bean	6
19	Folar 525 FW**	terbuthylazine + glyphosate	For the control of broad leaf weeds in coffee	6
20	Fuca 75 EW	Phenoxaprop-p-ethyl	For the control of Avena Spp. And Phalaris paradoxa on wheat	15
21	"Fusilade" Super 12.5% EC	fluzifop-p-butyl	For the control of grass weeds in cotton and fababean	2
22	Gesapax combi 500	ametryne + atrazine	For the control of various weed spp. in sugarcane	6

			REGISTERED HERBICIDES	
No.	Trade Name	Common Name	Approved Uses	Registrant
	FW*			
23	Gesaprim 500 FW*	atrazine 500g/l	For the control of complex weeds in maize and sorghum	6
24	Glycel 41% SL	Glyphosate 360 G/L SL	For the control of broad leaf weeds on coffee and waste land.	24
25	Glyfos 360 SL	glyphosate 36 SL	For the control of sedges and perennial grass weeds in coffee	5
26	Gramaxone 20% EC*	Paraquat	For the control of complex weeds in coffee plantation	6
27	Granstar 75 DF *	Tribenuron methyl	For the control of broadleaf weeds in wheat	5
28	Glyphogan T	Glyphosate + terbuthylazine	For the control of broad-leaved weeds on coffee	5
29	Glyphogan 480 SL	Glyphosate 480 G/L SL	For the control of coffee weeds such as <i>Cyprus</i> spp, <i>cynodon</i> spp, <i>Digitaria</i> spp, <i>Hydrocotyle</i> American, <i>Echinocloa</i> spp, <i>Bidens pilosa</i> , <i>Ageratum conyzoides</i> , <i>Galinsoga parviflora</i> and <i>Conyza albida</i>	5
30	Hellosate 48 SL	Glyphosate 48 SL	For the control of annual and perennial weeds in citrus plantations	15
31	Herb-Kill	2,4-D 720 gm/lt SL	For the control of broad leaf weeds on wheat.	31
32	Herbknock	2,4-D Amine Salt 720 G/L	For the control of annual & perennial broad leaf weeds on wheat.	33
33	Illoxan 28% EC*	Diclofop-methyl	For the control of wild oat and grass weeds in wheat and barley	4
34	Kalach 360 SL*	Glyphosate 36% SL	For the control of perennial grasses, sedges and broadleaf weeds in coffee	12
35	Lasso 480 EC	alachlor 480 G/L EC	For the control of broadleaf weeds in haricot bean	8
36	Lasso/Atrazine 55% SC*	alachlor 35% + atrazine 20%	For the control of annual weeds in maize, soybean and sugarcane	8
37	Litamine 72 SL	2,4-D	For the control of broad leaf weeds on wheat	15
38	Mamba 360 SL	Glyphosate	For the control citrus and coffee weeds	2
39	Mustang	(XDF 6.25 G/L + 2,4-D 300 G/L) Suspo-Emulsion (S.E)	For the control of broadleaf weeds in cereals	2
40	Pallas 45 OD	Pyroxulam	For the control of grass weeds (wild oat, downy brome / <i>Bromus</i> spp./ and annual broad leaf weeds on wheat.	2
41	Primagram 500 FW*	metolachlor + Atrazine	For the control of broad spectrum broadleaf and grass weeds in maize	6
42	Puma super 75 EW*	Fenoxaprop-p-ethyl 6.9%	For the control of grass weeds in wheat	4
43	Primagram Gold 660 SC	(s-metolachlor 290 g/l + Atrazine 370 g/l) SC	For the control of broadleaf and grass weeds in maize	6
44	QISH- Fordat	2,4-D	For the control of broadleaf weeds on wheat	4
45	Roundup 36 SL*	Glyphosate 360 g/l	For the control of complex weeds in coffee	8
46	Sanaphen D 720 SL	2,4-D 720g A.E/L,SL	For the control of Broad leaf weeds in wheat	2
47	Starane M 64% EC*	Fluroxypyr + MCPA	For the control of broadleaf weeds in wheat	2
48	Stomp 500 E*	Pendimethalin	For the control of rooboelia weed in maize	8
49	Topik 080 EC*	Cladinafop-propargyl	For the control of grass weeds in wheat	6

REGISTERED HERBICIDES				
No.	Trade Name	Common Name	Approved Uses	Registrant
50	U-46 KV fluid 600***	Mecoprop	For the control of broadleaf weeds in wheat and barley	3
51	U-46 D fluid 72% EC*	2,4-D 720g/l A.E	For the control of broadleaf weeds in cereal crops and sugarcane	3
52	Velpar 75 DF*	hexazinone 75% DF	For the control of broadleaf and grass weeds in sugar cane	2
53	2,4-D PA****	2,4-D 720 g/l A.E.	For the control of broad leaf weeds in wheat and teff	17
54	Weedkiller	2,4-D 72 Acid Equivalent	For the control of broadleaved weeds in teff and wheat	24
55	Zura Herbicide	2,4-D 720 g/l A.E	For the control of broad leaf weeds on maize.	26

\* Re-registered pesticide.

\*\* Cancelled from registration upon receipt of a notification, in writing, from the registrant of the pesticide that this specific formulation has been phased out from their production line.

\*\*\* Cancelled from registration upon receipt of a notification, in writing, from the registrant of the pesticide that it has been withdrawn from sale.

\*\*\*\* Registration expired.

**8.7.2.3 List of Registered Pesticides (Fungicides)**

REGISTERED FUNGICIDES				
No	Trade Name	Common Name	Approved uses	Registrant
1	Acrobat WG	Dimethomorph + Mancozeb	For the control of downy mildew on flowers.	29
2	Agri-Fos 400 SL	Potassium Phosphite	For the control of downy mildew on flowers.	27
3	Agro-Laxyl	mancozeb + metalaxyl	For the control of Early blight on tomato and Late blight on potato.	9
4	Aliette 80 WG	Fosetyl Aluminium 800 gm/kg	For the control of downy mildew, pythium & phytophthora on flowers	4
5	Ardent 50 SC	Kresoxim	For the control of powdery mildew on pepper.	5
6	Bayleton 25 WP*	triadimefon 250 g/l	For the control of rust diseases on wheat and barley.	11
7	Benlate 50 WP****	benomyl 50% WP	For the control of bean anthracnose on haricot beans	2
8	Bumper 25 EC*	propiconazole 25%	For the control of leaf and stem rust on wheat.	5
9	Collis 20% SC	Kresoxim-methyl + Boscalid	For the control of Powdery mildew on flowers.	29
10	CRUZATE R WP	cymoxinil + copper oxychloride	For the control of late blight on potato and downy mildew on grape.	2
11	Daconil 2787 W 75*	chlorothalonil 75% WP	For the control of coffee berry disease on coffee.	6
12	Flint WG 50	Trifloxystrobin 500 gm/kg	For the control of powdery mildew & rust on flowers.	4
13	Flosan FS	Thiram	For the control of root rot diseases on wheat	10
14	Folio Gold 537.5 SC	Metalaxyl-M 37.5 gm/l + 500 gm/l Chlorothalonil	For the control botrytis and downy mildew on flowers.	6
15	Helcozeb 80 WP*	mancozeb 80% W/W	For the control of cercospora leaf spot on statice flowers.	15
16	Impulse EC 500	Spiroxamine 500gm/lt	Fungicide for the control of powdery mildew on flowers.	4
17	Indofil M-45	mancozeb 80% WP	For the control of late blight on potato.	22
18	Iprodione 500 SC	Iprodione 500 gm/lt	For the control of botrytis and alternaria on flowers.	27
19	Kocide 101*	copper-hydroxide	For the control of late blight on potato.	5

\* Re-registered pesticide.

\*\* Cancelled from registration upon receipt of a notification, in writing, from the registrant of the pesticide that this specific formulation has been phased out from their production line.

\*\*\* Cancelled from registration upon receipt of a notification, in writing, from the registrant of the pesticide that it has been withdrawn from sale.

\*\*\*\* Registration expired.

## 9. Annex 9 - Reconnaissance Physical Cultural Heritage Survey

### ESIA REPORT ON MEGECH PUMP (SERABA) IRRIGATION & DRAINAGE PROJECT

#### *Reconnaissance Physical Cultural Heritage Survey*

##### TABLE OF CONTENTS

List of Tables	9-2
List of Photos	9-3
Abbreviations	9-4
<b>9.1 INTRODUCTION .....</b>	<b>9-5</b>
9.1.1 Authors	9-5
9.1.2 Physical Cultural Resources	9-5
9.1.3 Background to Survey	9-7
9.1.4 Regulatory Framework	9-9
9.1.4.1 Laws, Regulations and Guidelines	9-9
9.1.4.2 Institutions	9-10
9.1.5 Reconnaissance Physical Cultural Heritage Survey	9-10
9.1.5.1 Objectives	9-10
9.1.5.2 Approach	9-11
9.1.6 The Project Areas	9-11
9.1.6.1 Megech	9-11
9.1.6.2 Ribb	9-11
<b>9.2 SURVEY OBSERVATIONS .....</b>	<b>9-12</b>
9.2.1 Megech Area	9-12
9.2.1.1 Introduction	9-12
9.2.1.2 Narna Hill	9-12
9.2.1.3 Kurtiye Hill	9-13
9.2.1.4 Abba Taje Hill	9-14
9.2.1.5 Chehaldibi Hill	9-15
9.2.1.6 Religious Sites	9-16
9.2.1.7 Guramba Battlefield	9-17
9.2.1.8 Guramba Bata	9-18
9.2.1.9 Werengeb Bale Egziabher	9-19
9.2.1.10 Janbedel Muslim Graveyard	9-19

9.2.2	Ribb Area	9-19
9.2.2.1	Introduction	9-19
9.2.2.2	Reservoir Area	9-20
9.2.2.3	Askura Gabriel	9-20
9.2.2.4	Diversion Weir	9-20
9.2.2.5	Abwa Kokit Kebele	9-22
9.2.2.6	Nabega Giorghis Area	9-22
9.2.2.7	Churches in Fogera Woreda	9-23
<b>9.3</b>	<b>INITIAL ASSESSMENT &amp; RECOMMENDATIONS</b>	<b>9-24</b>
9.3.1	Overview	9-24
9.3.2	Specific Recommendations	9-24
9.3.2.1	Megech - General	9-24
9.3.2.2	Megech - Churches	9-25
9.3.2.3	Megech - Other Features	9-25
9.3.2.4	Ribb - Diversion Weir Area	9-25
9.3.2.5	Ribb - Churches	9-25
9.3.3	Contacts for Survey Tasks	9-25
<b>9.4</b>	<b>CONCLUDING REMARKS</b>	<b>9-26</b>
9.4.1	General	9-26
9.4.2	Updates	9-26
<b>9.5</b>	<b>REFERENCES</b>	<b>9-27</b>
<b>9.6</b>	<b>APPENDIX 1 - GPS RECORDS</b>	<b>9-28</b>
<b>9.7</b>	<b>APPENDIX 2 - PEOPLE AND ORGANISATIONS CONTACTED</b>	<b>9-29</b>
9.7.1	Appendix 2.1: ESIA Study Team Cultural Heritage Contacts in Addis Abeba	9-29
9.7.2	Appendix 2.2: People Contacted during Implementation of Reconnaissance Survey	9-30
<b>9.8</b>	<b>APPENDIX 3 - ITINERARY</b>	<b>9-32</b>
<b>9.9</b>	<b>APPENDIX 4 - HERITAGE SURVEY MAPS</b>	<b>9-33</b>
9.9.1	Map 1: Megech Pump (Seraba) Irrigation & Drainage Project - Sites Noted in Heritage Survey	9-33
9.9.2	Map 2: Ribb Irrigation & Drainage Project - Sites Noted in Heritage Survey	9-33

## LIST OF TABLES

Table 9-1: Types of PCR in Ethiopia	9-6
Table 9-2: Sites Visited in Megech Area	9-12
Table 9-3: Sites Visited in Ribb Area	9-19
Table 9-4: Churches in Potentially Affected Kebeles in Fogera Woreda	9-23

## LIST OF FIGURES

Figure 9-1: Narna Hill .....	9-13
Figure 9-2: Narna Hill - circular artefacts.....	9-13
Figure 9-3: Kurtiye Hill.....	9-14
Figure 9-4: Kurtiye Hill - stone artefacts.....	9-14
Figure 9-5: Abba Taje Hill - circular artefact .....	9-15
Figure 9-6: Chehaldibi Hill .....	9-16
Figure 9-7: Chehaldibi Hill - circular stone structure .....	9-16
Figure 9-8: Wawa K. Mihret - grave mound .....	9-17
Figure 9-9: Wawa K. Mihret - pottery fragments .....	9-17
Figure 9-10: Guramba Bata Church .....	9-18
Figure 9-11: Guramba Bata - clergy before midday mass .....	9-19
Figure 9-12: Ribb reservoir area from Farta Woreda side of river.....	9-20
Figure 9-13: Ribb River - old channel in Birkute Kebele .....	9-20
Figure 9-14: Ribb River - diversion weir area .....	9-21
Figure 9-15: Stone tools in field on Agita Kebele side of the river in Abba Roba locality.....	9-21
Figure 9-16: Artefacts in field on western side of Abba Roba locality.....	9-22
Figure 9-17: Wetland from compound of Nabega Giorghis Church, Dec. 20.....	9-23



## ABBREVIATIONS

AAU	Addis Ababa University
ARCCH	Authority for Research and Conservation of Cultural
BoCTPD	Bureau of Culture, Tourism and Parks Development
BP	Before Present
BRL	Bas-Rhône Languedoc
EA	Environmental Assessment
EPA	Environmental Protection Authority
ESIA	Environmental and Social Impacts Assessment
ETB	Ethiopian Birr
GPS	Global Positioning System
ICOMOS	International Council on Monuments and Sites
M	Million
MoWE	Ministry of Water and Energy
MoWR	Ministry of Water Resources
MPIDP	Megech Pump (Seraba) Irrigation and Drainage Project
OP	Operational Policy
PIT	Project Implementation Teams
PCR	Physical Cultural Resources
RIDP	Ribb Irrigation and Drainage Project
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank

# ESIA REPORT ON MEGECH PUMP (SERABA) IRRIGATION & DRAINAGE PROJECT

## *Reconnaissance Physical Cultural Heritage Survey*

### 9.1 INTRODUCTION

#### 9.1.1 Authors

Cultural Heritage Specialist, responsible for field survey:

P.I. Temesgen Burka Bortie

Lecturer in Archaeology and Cultural Heritage Management, Department of History and Heritage Management, Addis Ababa University

email: <te.falu60@gmail.com>, tel: 00-251-911-415-726

ESIA Team Leader, responsible for report expansion and editing:

James Ramsay

Environmental Specialist, BRLi, France

Email: <jramsay@horizon.bc.ca>, tel: 0910-196-376

#### 9.1.2 Physical Cultural Resources

Physical cultural resources (PCR, also known as cultural heritage or cultural property) are defined in the World Bank's Operational Policy (OP) 4.11 as "movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, palaeontological, historical, architectural, religious, aesthetic, or other cultural significance". A similar description is provided in Ethiopian Proclamation No. 209, 2000. Physical cultural resources may thus be:

Man-made (e.g. buildings, archaeological sites)

Natural (e.g. sacred places, historic trees, palaeontological sites)

Combined man-made and natural (e.g. cave paintings, sites used for ceremonies, burial grounds, battlefields)

Movable (e.g. religious artefacts, ancient books, statues, icons).

Categories of PCR for which Ethiopia is known are listed in Table 1, from the World Bank Group's *Physical Cultural Resources Profile* for Ethiopia (World Bank 2009).

**Table 9-1: Types of PCR in Ethiopia**

Type of PCR	Most Likely Location	Comment
<b>Archaeology</b>		
Historic sites	In highlands and urban settlements in lowlands	Virtually no archaeological research has been conducted; Ethiopia is unusually rich in indigenous historical sites.
Prehistoric sites	Found throughout the country, especially near rivers and flood plains	Very little archaeological research has been conducted, and sites are not easily recognizable.
<b>Palaeontology</b>		
Hominid remains (i.e. early human remains)	Associated with river basins, especially the Rift Valley	This is a type of PCR for which Ethiopia is especially well known.
<b>History</b>		
Castles, bridges, and palaces	Concentrated in the Lake Tana area	Many of these sites are unregistered and unknown outside of the local community.
Former historical seats of government	Throughout central plateau and urban settlements in lowlands	Many of these sites are unregistered and unknown outside of the local community.
Stelae and other remains of Axumite empire	Throughout the Tigre region	Many of these sites are unregistered and unknown outside of the local community.
<b>Architecture</b>		
Various types	Various locations	See historical and religious PCR.
<b>Religion</b>		
Churches and Monasteries	Throughout the highlands	Note monastic cave dwellings and rock-hewn churches in Tigre and Wolo. There is a dispute over whether religious PCR belongs to Orthodox church or government.
Mosques	Throughout lowlands, increasingly found in highlands	Unmarked on recent maps.
Synagogue	Gonder and Addis Ababa	Unmarked on recent maps
<b>Sacred Sites</b>		
Oromo trees	Oromo region	Known to local communities.
Sacred trees	Near churches	All trees near a church are sacred.
<b>Natural Features with Cultural Significance</b>		
Holy waters	Near churches and monasteries	Almost always unmarked.
Imperial trees	Central plateau, usually on mountains	Forests or woodstands with historic/imperial protection.
<b>Unique Human Settlements</b>		
Hideworkers	Southern lowlands	These are some of the only people known who regularly make and use stone tools.

Type of PCR	Most Likely Location	Comment
Isolated agricultural communities	Gorges of central plateau	These agricultural communities are difficult to reach.
<b>Tombs</b>		
Local Burial Grounds	Near any rural settlements	-
Monumental tombs and grave markers	Lake Tana and Tigre areas	-
Muslim tombs	Rift Valley and highlands	Decorated with paintings; an increasingly popular type of PCR.
Stone stelae (pillars)	Throughout lowlands and central plateau	-
Wood funereal statues (e.g. Konso waka)	Southern lowlands	Vulnerable to theft and illegal sale.
<b>Sites of Aesthetic Value</b>		
Gorges	Blue Nile area	Ethiopia does not currently get a large influx of tourists; however, these are potentially important tourist sites.
Lakes	Rift Valley, Lake Tana	Ethiopia does not currently get a large influx of tourists; however, these are potentially important tourist sites.
Scenic mountains	Begemder region (Simien), Rift Valley	Ethiopia does not currently get a large influx of tourists; however, these are potentially important tourist sites.
Waterfalls	Bahir Dar	Ethiopia does not currently get a large influx of tourists; however, these are potentially important tourist sites.
<b>Movable PCR</b>		
Coins	Throughout Ethiopia, especially around Axum	These are vulnerable to theft and illegal sale.
Religious objects (crosses, Christian and Muslim manuscripts, paintings, icons)	Throughout highlands	These are vulnerable to theft and illegal sale.

Source: World Bank (2009) Physical Cultural Resources Safeguard Policy Guidebook, Annex D1.

### 9.1.3 Background to Survey

The Lake Tana area of north-west Ethiopia is significant in terms of past human experience and ancient cultural developments. There is ample evidence to show that the Lake Tana region has served as a suitable environment for human exploitation of local resources since prehistoric times. However, there are very few scientific papers on the prehistory of the Lake Tana region; most archaeological work has been carried out in the Ethiopian north-eastern Lowlands and north-central Highlands rather than the north-western Highlands.

**Archaeology:** two papers exist to indicate the potential of the Megech area for important prehistoric remains: these are Moysey (1943) and Leakey (1943). Colonel Moysey found and excavated a rock shelter on a small hill east of Gorgora, and Louis S. B. Leakey analysed and described the stone tools (mainly waste chips) found at all depths within the shelter. The site showed evidence of continuous occupation by Early Man (Mesolithic onwards). At a similar period, Clark (1945) collected and described stone artefacts (bifaces) from a site east of Gonder.

On this basis, the ESIA study team initiated discussions with national and international specialists actively involved in archaeology in Ethiopia (see Appendix 2.1). Their opinion was that:

The Ethiopian Highlands are rich in archaeological and palaeontological sites, but very little work has been done on them.

Of primary scientific interest is evidence of lithic technologies (stone tools) of *Homo sapiens* and our predecessor *H. erectus*, dating as far back as 700,000 yrs BP. Sites include surface scatter, rock shelters and caves, eroding sediments, campsites, etc. To date, virtually all information on Early Man in Ethiopia has been from the Lowlands. Sites in the Highlands are a new window onto the foraging behaviour of early humans, as evidenced by new discoveries by the Blue Nile Basin Survey Project at Chilga Kernet just west of Gonder (Todd *et al.* 2003).

Other interests include huge fossil trees (just discovered) near Gonder and worthy of declaration as a national monument (they are so large that they are visible on Google Earth), Oligocene faunal remains up to 27 M yrs old (Kappelmann *at al.* 2003), and palaeobotanical remains.

These remains are found in sedimentary deposits on top of the volcanic basalt flood deposits which cover much of the Highlands (< 27 M yrs BP).

Professors Todd and Kappelman<sup>15</sup> have investigated the area immediately west of Gorgora, but have not written this up yet; the area has significant physical cultural heritage.

**Megech:** the rock shelter at Gorgora described by Moysey (1943) is close to the command area and therefore might be affected by the Megech Project.

The main canal from the pumping station will run along the boundary between the flat, wet lowlands and the drier hills to the west and north. This is a prime location for possible archaeological sites (campsites etc.).

The Megech Dam and Reservoir are likely to be in an area of sedimentary deposits with possible palaeontological interest.

**Ribb:** the lower reaches of the Gumera and Ribb Rivers run through recent sedimentary deposits which may contain fossils. The middle reaches and the sites of the dams and reservoirs are possible site for various types of remains, ranging from rock shelter sites to eroding fossiliferous sedimentary deposits.

The specialists concluded that:

The Lake Tana area is potentially rich in prehistoric cultural heritage sites, with direct evidence provided by the rock shelter site at Gorgora.

Therefore, it is essential that walk-over surveys are carried out by experienced specialists prior to finalisation of canal, drain and road layouts.

The large scale of irrigation and other water infrastructure works proposed, the potential scientific importance of the archaeological resources at risk, and limited local capacity, indicate a need for a rapid expansion of Ethiopian field archaeological capacity. The ESIA study could help initiate this important national capacity-building process.

**History:** Ethiopian historical sources for the mediaeval and post-mediaeval periods of Ethiopian history establish the significance of the region as a melting pot for different peoples and cultures over many years. From at least the 14<sup>th</sup> century the region was under pressure from the Amhara Solomonic dynasty rulers, which culminated in the confrontation between the Christian Highland Kingdom and the Muslim sultanates of the eastern lowlands in the 16<sup>th</sup> century, and finally the settlement and melting of the Oromos into the local fabric. A number of place names are evidence of such interaction of different cultural groups.

In both project areas - Megech and Ribb - a number of belief sites (Orthodox church sites with graveyards) claim an antiquity of over half a millennium.

<sup>15</sup> See Appendix 2 for affiliation and contact points.

## 9.1.4 Regulatory Framework

### 9.1.4.1 Laws, Regulations and Guidelines

Relevant Ethiopian laws, regulations and guidelines include:

- Environmental Impact Assessment Proclamation No. 299, 2002
- Environmental Impact Assessment Guideline Document, EPA, 2000

A Proclamation to Provide for Research and Conservation of Cultural Heritage No. 209, 2000 (which includes and supersedes the two previous proclamations, No. 229 of 1966 and No. 36 of 1989). This proclamation establishes the Authority for Research and Conservation of Cultural Heritage (ARCCH), defines and categorises cultural heritage, deals with cultural heritage management, and includes provisions for the exploration, discovery and study of cultural heritage.

Ethiopia is also a party to the UNESCO World Heritage Convention.

"Impact" according to Ethiopian Proclamation No. 299, 2002, is "any change to the environment or to its component that may affect human health or safety, flora, fauna ... natural or cultural heritage, other physical structure, ...".

The exact wording of the important article on chance discoveries in Proclamation No. 209, 2000 is given in Box 1 (below).

Relevant World Bank policies and guidelines include:

- Operational Policy: OP 4.01 Environmental Assessment, 1999, together with numerous supporting procedures, guidelines and manuals
- Operational Policy: OP 4.11 Physical Cultural Resources, 2006
- Bank Procedures: BP 4.11 Physical Cultural Resources, 2006
- Physical Cultural Resources Safeguard Policy Guidebook, 2009 (this presents practical guidance on application of the Bank's heritage policy during project preparation)

Box 1: Extract from Proclamation 209, 2000

Article 41. Fortuitous Discovery of Cultural Heritage

Any person who discovers any cultural heritage in the course of and excavation connected with mining explorations, building work, road construction or other similar activities or in the course of any other fortuitous event, shall forthwith report same to the Authority (ARCCH), and shall protect and keep same intact, until the Authority takes delivery thereof.

The Authority shall, upon receipt of a report submitted pursuant to sub article (1) hereof, take all appropriate measures to examine, take delivery of, and register the cultural heritage so discovered.

Where the Authority fails to take an appropriate measures within six month in accordance with sub-article (2) of this Article, the person who has discovered the Cultural Heritage may be released from his responsibility by submitting, a written notification with a full description of the situation, to the Regional government official.

The Authority shall ensure that the appropriate reward is granted to the person who has handed over a cultural heritage discovered fortuitously in accordance with sub-articles (1) and (2) of this Article. And such person shall be entitled to reimbursement of expenses, if any, incurred in the course of discharging his duties under this Article.

Key clauses from the Bank's OP 4.11 are given in Box 2 (below).

**Box 2: Extract from World Bank OP 4.11**

**Physical Cultural Resources within Environmental Assessment**

The borrower identifies physical cultural resources likely to be affected by the project and assesses the project's potential impacts on these resources as an integral part of the EA process, in accordance with the Bank's EA requirements.

When the project is likely to have adverse impacts on physical cultural resources, the borrower identifies appropriate measures for avoiding or mitigating these impacts as part of the EA process. These measures may range from full site protection to selective mitigation, including salvage and documentation, in cases where a portion or all of the physical cultural resources may be lost.

As an integral part of the EA process, the borrower develops a physical cultural resources management plan that includes measures for avoiding or mitigating any adverse impacts on physical cultural resources, provisions for managing chance finds, any necessary measures for strengthening institutional capacity, and a monitoring system to track the progress of these activities. The physical cultural resources management plan is consistent with the country's overall policy framework and national legislation and takes into account institutional capabilities with regard to physical cultural resources.

Together, these national frameworks and international requirements provide clear guidance on steps to be taken when considering implementation of projects which could affect physical cultural heritage.

**9.1.4.2 Institutions**

Within Ethiopia, the cultural heritage authority is the Authority for Research and Conservation of Cultural Heritage (ARCCH). This has its headquarters in Addis Ababa, and is the responsibility of the Ministry of Information and Culture.

At regional, zonal and woreda (district) levels, heritage issues are managed and administered by the respective Bureaus of Culture and Tourism. In the Amhara National Regional State, the responsible office is now termed the Bureau of Culture, Tourism and Parks Development (BoCTPD).

Other important national institutions with heritage interests include the National Museum, Addis Ababa University's Institute of Ethiopian Studies, History Department, and School of Architecture, the Ethiopian Orthodox Church, and other religious organisations.

Key international organisations with Ethiopian representation are the International Council on Monuments and Sites (ICOMOS), and UNESCO.

## 9.1.5 Reconnaissance Physical Cultural Heritage Survey

**9.1.5.1 Objectives**

Given the existence of known and potential physical cultural heritage in the project areas (see Section 9.1.3 above), it was necessary to determine the possible location and scale of cultural heritage issues. The first step in any such determination is the implementation of a reconnaissance survey. In this case, the objectives of the survey were to:

Characterise the physical cultural resources of the areas of the Megech/Seraba and Ribb irrigation and drainage projects;

Undertake a walkover of selected areas to investigate their cultural significance from visible cultural remains, as an input to predicting possible impacts, and

Identify further actions required to fill information gaps and mitigate potential significant impacts, if any.

### 9.1.5.2 Approach

Following office-based research and preparation, fieldwork was carried out from 6<sup>th</sup>-17<sup>th</sup> December 2009 in North and South Gonder Zones and specifically in Dembia, Libo Kemkem, Ibnat, Farta and Fogera Woredas. The fieldwork was a reconnaissance physical cultural heritage survey to investigate the possible impacts of the two irrigation and drainage projects on the region's physical cultural resources. The assessment was carried out in accordance with national and international guidelines.

Methods and techniques adopted included:

Review of literature dealing with the regional history of the project areas;

Review of relevant Ethiopian environmental and cultural legislation;

Visit to the project areas to contact relevant government authorities, the region's project implementation teams, and key informants such as local representatives (elders), and religious leaders (clergy);

An initial walk-over site survey of key locations to locate cultural centres and record important localities with GPS and camera.

The survey party consisted of (i) an Ethiopian cultural heritage specialist (a lecturer in archaeology and cultural heritage management from AAU), and (ii) a French rural sociologist (the ESIA team's lead sociologist), and was accompanied to most sites by staff from the local administrations as well as local residents.

GPS coordinates of key sites are given in Appendix 1. People and organisations contacted are listed at Appendix 2. The survey party's itinerary is given at Appendix 3.

## 9.1.6 The Project Areas

The two project sites under study are the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) and the Ribb Irrigation and Drainage Project (RIDP), together with the Ribb Dam, reservoir and diversion weir (Maps 1, 2, Appendix 4).

### 9.1.6.1 Megech

The Megech project is close to the Lake Tana shore south of the Gonder - Bahir Dar road and east of the Gonder - Gorgora road (Map 1 in Appendix 4).

The full Megech irrigation and drainage project comprises four sub-schemes. The MPIDP is the first to be developed and lies fully in Dembia Woreda of North Gonder Zone.

Eight kebeles are included fully or partially in the command area of the Megech project: Aberja, Achera Mariam, Arabia Adisge, Chankua, Debre Zuria, Guramba Bata, Jangua Mariam, and Seraba Dabelo (source: MPIDP final Feasibility Study, Feb. 2010).

### 9.1.6.2 Ribb

The Ribb project is planned to benefit a number of Kebeles in two Woredas of South Gonder Zone, namely Libo Kemkem and Fogera (Map 2 in Appendix 4). Sufficient water is available for some 11,000 ha using gravity irrigation techniques, or 14,000 ha if advanced techniques such as pressurised irrigation are adopted. The command area would be on both banks of the Ribb River. Water will be supplied from a reservoir behind the Ribb Dam, which is now under construction. Water will be released from the reservoir into the Ribb River, and diverted 28 km downstream at a weir into a short head canal which will then split into two main irrigation canals, one on each side of the river.

The project's design is at feasibility stage; 14 kebeles will be partly or fully within the command area in Libo Kemkem Woreda - Agita, Angot, Bambiko, Bira, Birkute, Bura, Estifanos, Genda-weha, Kab, Shamo, Shina-Tsion, Tibaga, Tizamba, Yifag, and 8 kebeles in Fogera Woreda - Addis Betekristian, Abwa Kokit, Diba Sifatra, Ribb Gabriel, Shaga, Tiwuha Zekena, Watambi, Wereta Zuria (source: Ribb Feasibility Study, Jan. 2010).



## 9.2 SURVEY OBSERVATIONS

### 9.2.1 Megech Area

#### 9.2.1.1 Introduction

Sites visited during the survey are listed in Table 2 and described below. Their locations are shown in Map 1 in Appendix 4.

**Table 9-2: Sites Visited in Megech Area**

	Name	Comment	Location		
			Inside Command Area	Close to Command Area	Outside Command Area
1	Narna	Hill: rock shelter with cultural imprints on the floor and outside the shelter			X
2	Field near future pumping station	Field: stone tools on grassy surface	X		
3	Kurtiye	Small hill: pottery shards and stone tools	X		
4	Abba Taje	Hill: circular holes in the rock, pot shards			X
5	Chehaldibi	Hill: circular stone structure, mounds on western side, current snake beliefs	X		
6	Wawa Kidane Mihret	Church: on edge of command area, rich in pot shards		X	
7	Dahna Gabriel	Church: outside command area, rich in cultural remains (pottery)			X
8	Guramba Battlefield	Cultivated plain: exact site of 1852 battle is uncertain			X
9	Guramba Bata	Ancient church, close to the future main canal	X		
10	Werengeb Bale Egziabher	Church: inside command area south-west of Guramba, pottery shards on surface all around	X		

#### 9.2.1.2 Narna Hill

Narna Hill is the site of the rock shelter excavated by Moysey (1943). It is located north of Gorgora town along the unpaved road to Wawa Horticultural Farm and the future pumping station (Map 1, Fig. 1).

Pearson (pers comm., 2009) mentions scatters of lithics all around the base of the hill. These were not observed during the current rapid inspection, however other remains indicate significant past use by humans (Fig. 2).



**Figure 9-1: Narna Hill**

Narna Hill from the west; the small seasonal stream mentioned in Moysey (1943) is to the right. The hill is outside the command area but adjacent to the access track from Gorgora which runs close to its base. The command area floodplain is visible beyond the figure to the left.



**Figure 9-2: Narna Hill - circular artefacts**

On the front side of the hill (as observed from Fig. 1) and below one of the shelters on top of the hill are circular excavations in the rock made by humans. The period and the significance of such cultural features are not yet known. The coordinates for the three circular features photographed are 12.2543N, 037.28400E. The pen indicates scale.

The site is highly accessible and therefore at risk from intensification of human activities. The finding of the imprints in Fig. 2, together with the rock shelter and the reports of stone artefacts, call for further study of this site.

### 9.2.1.3 Kurtiye Hill

This site is close to the shore of Lake Tana (Map 1, Appendix 4). It comprises a relatively level grassy field on a ridge, adjacent to a rocky hill locally called Kurtiye (this is surmounted by three disused water storage tanks from a former East German aid project).

The landscape setting of the area is indicative of its suitability for use by humans to exploit the resources of the lake, even (or especially) at past higher water levels.

A short walk-over survey of the area yielded artefacts indicative of past human activities: stone scrapers scattered on different parts of the field and hill, and also pottery shards (Figs. 3, 4).

Depending on the exact final design and layout details - and the extent of the physical remains - this site may be affected by improved access and a significant increase in human activities. The site of the pumping station is understood to be approx. 1 km to the south, and was not inspected.



**Figure 9-3: Kurtiye Hill**

Kurtiye Hill north of the pumping station site and near the main canal. Scattered stone tools were found in the field where the two men are standing. On the stone-paved track up the hill are pottery fragments and stone tools. There is a high potential for physical cultural resources in the surrounding area (around coordinates 12.26285N, 037.30242E).



**Figure 9-4: Kurtiye Hill - stone artefacts**

A variety of stone artefacts collected from the field adjacent to Kurtiye Hill. It is clear from microliths spread over the area that prehistoric man used this site to exploit the rich environment of the lake and lake margin.

#### **9.2.1.4 Abba Taje Hill**

This small hill is located close to the road from Gonder to Gorgora, close to and west of Narna hill (Map 1, Appendix 4).

According to one local farmer (a guard for Wawa Horticultural Farm), a number of pots have been found when cultivating land nearby. Another farmer reported that local residents are hosting a pot found underground (further enquiry is necessary to locate it). Such information is consistent with observation of widespread pottery shards on the farmland around the hill.

In addition, on the top of the hill are circular holes similar to those at the Narna site. They are carved in two places in different parts of the top of the hill, in solid rock (Fig. 5).

Being adjacent to the main road, the site is highly accessible and therefore potentially at risk from intensification of human activities. The finding of the imprints in Fig. 5, together with the pottery shards, calls for further study of this site.



**Figure 9-5: Abba Taje Hill - circular artefact**

Unidentified cultural remains (purpose unknown): a circular hole with internal surfaces indicative of the use of fire or soot (carbon).

#### 9.2.1.5 Chehaldibi Hill

This site is a hill located in the middle of the plain within the Megech (Seraba) command area (Map 1, Fig. 6). It is also known locally as Chehaldibit or Kumbullo Terrara, and is about 2 km north of Narna Hill. It is within the command area. The coordinates for the top of Chehaldibi are 12.2753N, 037.27670E, and its GPS elevation is 1836 m a.s.l.

This site was visited because of its similarity with Narna Hill, and because a previous rapid visit by an archaeologist revealed that it was covered with lithic debris, much of microlithic debitage<sup>16</sup>, although virtually all of the soil that once may have been on the hill has eroded away (Pearson, pers. comm., 2009).

A walk-over survey around the foot of the hill (is not easy because of grass, thorny bushes and field crops) and to its summit resulted in discovery of evidence of cultural activity on the western side of the hill (Fig. 7). Here there is a circular stone structure about 6 m in diameter. On the corner of the main structure and inside are about four stone mound-like structures.

According to local farmers who accompanied the survey party, no recent activity is known to have been conducted on the hill. The local inhabitants are afraid of climbing the hill because it is believed that a python is living there. This suggests that the hill may have a history of serving as a ritual site related to belief in snakes, particularly before Christianity spread to the region.

Implementation of the project could affect Chehaldibi by improving both access and demands for building materials, in the worst case leading to dismantling of the stone structure, or perhaps illegal excavation by treasure hunters.

<sup>16</sup> Microlithic debitage: the small stone chips created when making stone tools.



**Figure 9-6: Chehaldibi Hill**

Chehaldibi (Kumbullo) viewed from south-east (western side of hill under sunset light).



**Figure 9-7: Chehaldibi Hill - circular stone structure**

Part of a circular stone structure and mounds on the western side of the hill. There is no indication of any earthwork associated with this structure. At about 6 m in diameter, it appears too big for the wall of a typical round rural house.

The potential importance of the site indicates that a detailed survey is required. Any such survey should include both the immediate locality and the alignment of the main canal up to Wawa, including Narna Hill and the areas around Dahna Gabriel and Wawa K/Mihret Churches.

#### **9.2.1.6 Religious Sites**

The Amhara region, particularly the area under consideration, is widely known for its rich historical cultural heritage. Some important religious sites, such as the Monastery of Debre Sina at Gorgora, will not be directly affected by the project. However, other churches could be affected, either physically through effects such as changes in groundwater conditions, or functionally through changes in access resulting from the excavation of canals and drains. The obvious mitigation measure for interrupted access is construction of footbridges at appropriate locations.

One church to which access would clearly be affected by construction of the main canal is Wawa Kidane Mihret. The church is close to but outside the command area, at 12.27456N, 037.26789E (Map 1). Appropriate bridge facilities will be required. Old stone-covered grave mounds exist in the church compound, and pottery shards occur in the vicinity (Figs. 8, 9).



**Figure 9-8: Wawa K. Mihret - grave mound**

Grave mound in the compound of Wawa K. Mihret. Note, only some stone structures are visible due to the vegetation. The coordinates for the church were taken close to this grave.

The pot shards collected at the church and other similar remains on the surface and in the farms around are not of recent production, and they are likely to be of considerable antiquity.

The other church close to and overlooking the Dahna and Wawa plains is Dahna Gabriel (Map 1, Appendix 4). Abundant pottery fragments were observed here, characteristic of the environment stretching across the plains via Narna to the lakeshore around the pumping station.



**Figure 9-9: Wawa K. Mihret - pottery fragments**

Pottery fragments collected from the surface near the church, probably by children. This is a good example of pressure on cultural features when awareness is low, particularly on archaeological remains such as pot shards and stone tools.

#### **9.2.1.7 Guramba Battlefield**

The MPIDP command area stretches northwards close to the historical battlefield called Guramba. The Battle of Guramba is important in modern Ethiopian history, for it was here that the future Tewodros II, the then Kasa of Quara, crushed Daj. Goshu Zewudie of Gojam fighting under Ras Ali. This was on 27 Nov. 1852. Guramba therefore comprises a very significant historical landscape requiring serious consideration, together with Gorgora Bichen, another successful battle for Tewodros.

The plain north-east of Guramba is very extensive and the precise location of the battlefield is not clear, although a local elder showed the survey team what he believes to be the site (this is "oral history"). As yet, no battlefield archaeological survey has been conducted and documented.

The battlefield is probably outside the MPIDP command area (Map 1, Appendix 4). Nevertheless, intensification of agriculture in the Dembia Plains as a direct or indirect result of the MPIDP or the other Megech irrigation projects could affect buried battlefield features. This suggests that it would be wise to attempt to survey and document the battlefield before development brings significant physical changes to the area.

### 9.2.1.8 Guramba Bata

Guramba Bata<sup>17</sup> is a church located at the end of the main canal, at 12.34373N, 037.32794E (Map 1, Appendix 4). The church is close to a benchmark installed by the project design team through which the canal will pass.



**Figure 9-10: Guramba Bata Church**

Guramba Bata Church, recently renovated by a philanthropist. Many changes (roof, walls, doors and pillars) were made during renovation except for the circular structure in the interior of the church. Such changes are characteristic of churches undergoing renovation in Amhara region in recent years.

The church (Fig. 10) serves more than 500 local residents, according to the head of the clergy Mekonnen Yirdaw and his colleagues (Fig. 11). It is over 400 years old, having been built during the reign of Emperor Susenyos (1616 - 1632). During the regime transfer of 1991/2 the church was attacked by treasure hunters and several ancient books were stolen, according to the clergy. It also houses "many Arks".

The church lands are reported to be under pressure from farmers, who do not respect the boundaries (which are uncertain) and are encroaching. Coordination with the authorities during MPIDP implementation might reduce or stop this process.

The proximity of the main canal to the church compound is a concern, particularly in relation to direct effects on possible unmarked ancient burials outside the existing compound boundaries. The effect of dry-season irrigation on groundwater levels close to the church are also a concern, although groundwater should, in theory, be controlled by land drains. There is a remote possibility that in the long term, raised dry-season humidity could affect ancient manuscripts and fabrics.

Access arrangements across the main and secondary canal at this location will be important.

<sup>17</sup> Bata = third day of the Ethiopian month dedicated to St. Mary.

### 9.2.1.9 Werengeb Bale Egziabher

The survey party walked from Guramba Bata to Werengeb Bale Egziabher, a church some 2.5 km to the south-east, well inside the command area. Pottery fragments were observed scattered in the fields, especially close to the church.



**Figure 9-11: Guramba Bata - clergy before midday mass**

### 9.2.1.10 Janbedel Muslim Graveyard

Local informants in Guramba reported that in Arebia Abba Libanos Kebele, next to Guramba, there is an ancient Muslim graveyard. This is visited by pilgrims despite there being no local residents who are followers of the religion. The site is known locally as Janbedel. Time and access constraints did not allow a visit to the site. However, the Dembia Woreda Culture and Tourism Office has plans to document the site and its significance.

## 9.2.2 Ribb Area Introduction

The objectives of visiting this project area included (i) making a short survey of the Ribb dam and reservoir area for possible cultural remains as well as for sedimentary exposures potentially important for archaeological and palaeontological remains, (ii) to visit the diversion weir area for similar purposes, (iii) to check on some points where prehistoric and historical cultural remains have been identified, and (iv) to make an initial assessment of the possible impacts and appropriate responses.

Accordingly, the sites listed in Table 3 and described below were visited for rapid walk-over surveys. Site locations are given in Map 2, Appendix 4.

**Table 9-3: Sites Visited in Ribb Area**

	Name	Comment	Location		
			Inside Command Area	Close to Command Area	Outside Command Area
1	Ribb reservoir	Eroded grassland: no significant remains observed			X
2	Askura Gabriel	Church: modern			X
3	Diversion weir site	Pasture: significant pottery remains on the surface		X	
4	Abba Roba Got (hamlet)	Pasture and fields: rich in pottery fragments and polished stones, grinding stones, on both sides of the river around the future weir		X	
5	Abwa Iyesus	Ancient church: close to the Ribb river in Fogera plain, no land certificate	X		
6	Nabega Giorghis	Ancient church: indigenous trees, burial site of well-known persons (e.g. Alaqa Gebrehana)		X	



### 9.2.2.2 Reservoir Area

The Ribb Dam is under construction. The area around and upstream of the damsite (Map 2, Appendix 4) is highly eroded. There is no significant habitation between the dam (in Ibnat and Farta Kebeles) at 12.06466N, 037.92541E, 1939 m a.s.l. (Fig. 12) and Birkute Kebele (for example, at 12.10186N, 037.93610E).

No significant cultural remains, prehistoric or historic, were observed during a survey of about two hours along both sides of the Ribb River in the reservoir area upstream of the dam, in Ibnat and Farta Woredas.



**Figure 9-12: Ribb reservoir area from Farta Woreda side of river**

### 9.2.2.3 Askura Gabriel

Askura Gabriel is a modern church (founded in 1997) on the right (north) side of the Ribb River, in Birkute Kebele (Map 2, Appendix 4). It is not at risk from the project's infrastructure.

### 9.2.2.4 Diversion Weir

Water released from the reservoir will flow some 28 km down the Ribb to a diversion weir (Map 2, Appendix 4). The weir is to be constructed at a locality known as Abba Roba, where some of the land is under cultivation and some is pasture. Near location the river has created a new channel leaving a visible old channel (Figs. 13, 14).



**Figure 9-13: Ribb River - old channel in Birkute Kebele**

Old channel of the Ribb River in Birkute Kebele at the foot of the hill where Askura Gabriel church is situated (coordinates for the church: 12.06466N, 037.92541E, 1918 m a.s.l.)



**Figure 9-14: Ribb River - diversion weir area**

Ribb River weir area, photo from north side of river (Agita Kebele, Libo Kemkem Woreda). The new channel developed recently, showing the strength of the floods during the summer.

Unlike the upstream area which is characterised by an eroded and degraded landscape, the Agita - Ribb Gabriel - Addis Betekristian area is very rich in significant cultural remains. Two important aspects should be noted: (i) an Oromo name (Abba Roba) for the diversion weir locality, despite no local inhabitant claiming Oromo descent, and (ii) a high concentration of pottery fragments, polished stone items and grinding stones on the surface in fields (Figs. 15, 16).



**Figure 9-15: Stone tools in field on Agita Kebele side of the river in Abba Roba locality**

Stone tools in a field on the Agita Kebele side of the river in Abba Roba locality. The farmer and other inhabitants of the area report being always amazed by these features, whose origin they do not know - except that they heard from elders that once upon a time unknown people occupied this area. It is clear from a walk-over of the site that many remains of human activities are present.



**Figure 9-16: Artefacts in field on western side of Abba Roba locality**

Fragment of grinding stone, pottery fragments and stone tools in a field on the Agita Kebele side of Abba Roba locality.

#### **9.2.2.5 Abwa Kokit Kebele**

The survey party visited Abwa Iyesus church in Abwa Kokit Kebele on the left bank of the Ribb. At this location discussions were held with the clergy, Woreda staff, Kebele staff and the head of the local Women's Association called "Genet Got".

The church dates back to the era of Seiferad in the 14<sup>th</sup> Century. The church owns land but does not have a land certificate. Local residents are aware of the project, but do not have details of the location of the proposed infrastructure, and therefore remain concerned as to potential impacts on land and heritage features such as graveyards.

#### **9.2.2.6 Nabega Giorghis Area**

Nabega Giorghis is an ancient church (Table 3) in Nabega Kebele downstream of the command area in Fogera Woreda (Map 2, Appendix 4). The site was visited at the insistence of the Woreda administration, who are very concerned that Nabega Kebele should be included in the project.

The church compound supports a variety of indigenous tree species. The clergy reported that the increase in population has put pressure on available space for burials, so much so that new burials take place on top of old ones, and "bones are revealed". The burial sites around the church are not easy to identify since there is no culture of stone markings, only earthen mounds.

The lands of Nabega Giorghis are said to be under pressure from encroachment by farmers. The land re-organisation exercise to be conducted by the project could mitigate this problem by firmly establishing everyone's property rights and boundaries.

Locally, there is concern that improved access to the kebele as a result of the project (until now access is limited to the dry season) would increase the risk of theft of treasures from this and other churches and monasteries.

Also, as at Megech, construction of canals and drains could affect access to churches by their congregations. Local informants were concerned that all new channels should include bridges, with locations selected in close consultation with local residents and their representatives.

Being close to Lake Tana and with significant wetland resources, Nabega Kebele provides substantial habitat for international migratory birds, especially in Shesher Pond and Welela Pond (Fig. 17) near Nabega Giorghis. The Woreda Culture and Tourism Office hopes to develop tourism with this area as a key eco-attraction. However, local farmers' pressure for land is affecting the wetlands and reducing their extent. In recognition of their ecological importance, it is understood that measures to provide the water necessary for continued functioning of the wetlands will be included in the project design.



**Figure 9-17: Wetland from compound of Nabega Giorghis Church, Dec. 2009**

### 9.2.2.7 Churches in Fogera Woreda

The Fogera area is home to a number of old-established churches. Table 4 lists the churches in the potentially project-affected Kebeles in Fogera Woreda. Their remarkable age reflects the expansion of state power and Christianity in the region in the post-Zagwe Kingdom period of the 13<sup>th</sup> Century AD.

**Table 9-4: Churches in Potentially Affected Kebeles in Fogera Woreda**

No.	Name of Church	Kebele	Foundation Date (Western Calendar)
1	Shaga Mariam	Shaga	1437
2	Dibba Giorghis	Dibba Sifatra	1674
3	Sifatra Mariam	Dibba Sifatra	1875
4	Ribb Gabriel	Ribb Gabriel	1252
5	Qinchib Tsion	Ribb Gabriel	1714
6	Robgebeya Mariam	Ribb Gabriel	1255
7	Dewel Mariam	Watambi	1654
8	Gubdatsion	Watambi	1355
9	Betekristian Mariam	Addis Betekristian	1500
10	Gubtsion	Addis Betekristian	1355
11	Ribb K. Mihret	Addis Betekristian	1526
12	Abwa Iyesus	Abwa Kokit	1355
13	Kokit K. Mihret	Abwa Kokit	1674
14	Nabega Giorghis	Nabega	1340s?

*Source: Consultant, from records at Fogera Woreda Culture & Tourism Office.*

## 9.3 INITIAL ASSESSMENT & RECOMMENDATIONS

### 9.3.1 Overview

The project areas are both rich in cultural remains of various types. However, there is a major information gap about the cultural significance of the region in general and the project localities in particular. Consequently, in accordance with both national and international guidance, and to avoid hold-ups in implementation due to discoveries at a later date, it would be appropriate to:

**Undertake detailed surveys of limited localities prior to construction**, specifically (i) at and around the pumping station site and main canal alignment at Megech, and (ii) at and around the diversion weir site at Ribb. The investigating team should be multi-disciplinary (archaeologist, historian, linguist, geologist).

Attach a qualified and experienced archaeologist to the supervision team during earthworks in sensitive locations.

**Establish clear chance find procedures for implementation during construction.** For this purpose, the Amhara Culture and Tourism Bureau (under Ato Mulugeta Seid, the Regional Project Coordinator) has agreed to provide available expertise whenever chance finds are reported.

Considering the importance of the various historic and prehistoric remains and sites to the living culture and tourism potential of the region, it is also strongly recommended that:

The Project Implementation Teams (PITs) should be expanded to include representation from the respective Culture and Tourism Offices, at all administrative levels.

Notes:

these recommendations are DRAFT, and are to be discussed with the concerned authorities before finalisation;

the agreed measures will be incorporated in the Environmental Management Plan in the ESIA as a Physical Cultural Resources Management Plan.

the Terms of Reference for preparation of the Resettlement Action Plans for the Megech and Ribb projects includes the task "Determine the impact on cultural property and prepare a plan for relocation and restoration in consultation with local groups". Therefore it will be important to coordinate between the ESIA and the RAP study in relation to further development of the projects' heritage management approach.

### 9.3.2 Specific Recommendations

#### 9.3.2.1 Megech - General

This reconnaissance survey has confirmed previous indications that the area near Gorgora within which the project's construction activities will be undertaken is rich in physical cultural resources (tangible cultural heritage: prehistoric sites at Narna, Chehaldibi, Abba Taje and Kurtiye Hill with significant stone artefacts on the surface). Other sites may exist but are, as yet, undiscovered.

The preferred response is an intensive survey and documentation of heritage sites within and near the project's physical footprint before the earthworks are started. The survey would also define sensitive areas for close supervision during construction, and generate management recommendations for known PCR.

A first approximation of the resources required is a small, multi-disciplinary team (archaeologist, historian, linguist and geologist) with five labourers for 10 days in the field, plus two days for travel to and from Bahir Dar. Costs are estimated at ETB 100,000 for the field survey, plus lab analysis and writing-up time, which will be dependent on finds.

In addition (and in any case) **an archaeologist should be attached to the construction supervision team during major earthworks activities in sensitive areas**, including the development of quarries and borrow pits. The archaeologist should have direct links to the Resident Engineer or other senior Employer's representative, so that appropriate procedures can be initiated immediately should any remains be encountered.

### 9.3.2.2 Megech - Churches

Two churches in Dembia Woreda (Guramba Bata and Wawa K. Mihret) are close to the main canal. The church leaders confirmed that they have agreed with the authorities that no canal or drain will directly affect the church compounds, and inspection of the feasibility-level layout indicates that care has been taken to avoid direct impacts on known church property. However, in the case of Guramba Bata this is one of the oldest churches in the area, and there is no certainty as to the boundaries of the church compound in the past or to the location of all burial sites associated with the church. Consequently **a close watch will be needed when undertaking construction activities around Guramba Bata church.**

Project implementation is likely to affect access to churches by local residents due to the construction of many km of new irrigation and drainage channels (and some new access tracks). **It is important that local communities are consulted to clarify the number, type and positioning of bridges.** This can be done during detailed design.

Note: Achera Mariam Church (in Dembia Woreda) is said to be flooded by the Megech River in summer. It is uncertain how much the MPIDP will alleviate this problem. However, completion of the Megech Dam should result in full control of flooding in the Megech River.

### 9.3.2.3 Megech - Other Features

**Muslim graveyard:** the potential impact of the project on the ancient Muslim graveyard ("Janbedel") in Arabia Abba Libanos Kebele of Dembia Woreda cannot be assessed without additional information. **The site should be investigated by a historian in cooperation with the concerned Culture and Tourism Offices** to determine what further steps should be taken, if any.

**Guramba Battlefield:** as a lower priority, the location of the battlefield should be determined so that appropriate conservation and management measures can be taken prior to its development by the Megech gravity irrigation and drainage project.

### 9.3.2.4 Ribb - Diversion Weir Area

This reconnaissance survey has found that the location to be affected by the project's planned diversion weir and canal headworks is rich in physical cultural resources (tangible cultural heritage), expressed as stone and pottery remains on the surface.

As at Megech, the preferred response is an **intensive survey and documentation of heritage sites before the earthworks are started.** Resource requirements are as for Megech (see Section 9.3.2.1 above).

In addition (and in any case) an archaeologist should be attached to the construction supervision team during all earthworks activities, including the development of quarries and borrow pits.

### 9.3.2.5 Ribb - Churches

As at Megech, project implementation is likely to affect access to churches by local residents due to the construction of many km of new channels (and some new access tracks). **It is important that local communities are consulted to clarify the number, type and positioning of bridges.**

## 9.3.3 Contacts for Survey Tasks

Appropriate personnel for the recommended pre-construction surveys can be sourced through the Regional Bureau of Culture, Tourism and Parks Development (BoCTPD) in Bahir Dar. Contacts:

- Ato Abebe Mengistu (archaeologist) 0911-537-362
- Ato Gashaw (cultural expert) 0911-016-330
- For other experts: contact the ENIDP Regional Project Coordinator and Head of the BoCTPD:
- Ato Mulugeta Seid, 0918-340-179.

Note that skilled field personnel ("spotters") exist in the region, having gained experience through internationally-sponsored archaeological research expeditions. They can be contacted through national and international archaeologists involved in, for example, the Blue Nile Basin Survey Project which has been active at Chilga near Gonder.

## 9.4 CONCLUDING REMARKS

### 9.4.1 General

The Gonder region, historically known as Begemidir, has served as fertile ground for cultural developments, both prehistoric and historic.

A reconnaissance survey by a cultural heritage specialist and rural sociologist in the project areas in Dembia, Libo Kemkem, Fogera, Ibnat and Farta Woredas in December 2009 confirmed previous indications of rich physical cultural resources (archaeological and religious) in both locations. The project areas are important, or potentially important, for both historical and living culture, and also have some economic potential for future tourism development. However, there is little documented information on these sites and features.

Project implementation is likely to affect some of these heritage resources, especially through the direct impact of earthworks during construction, or subsequently through changes in physical conditions such as groundwater or improvements in access. Their conservation, in accordance with national and international regulations and guidelines, requires:

- Inclusion of cultural heritage as a key topic in further stages of project planning and implementation.
- Close cooperation and consultation with local stakeholders.
- Further scientific investigation, on-site.
- Follow-up actions based on the findings of the detailed surveys.

This survey illustrates the importance of integrating cultural heritage impact assessment into development activities in Ethiopia.

### 9.4.2 Updates

The findings of the reconnaissance survey were discussed with the ARCCH on 08 March 2010. This led to a further meeting to discuss the way forward involving the ARCCH, the ESIA Consultant and a representative of MoWR on 24 March 2010. Following the second meeting ARCCH prepared a proposal for a rapid archaeological impact assessment of both project sites to be carried out by specialists from the Authority and AAU. The survey would involve six professionals: historic and prehistoric archaeologists, a palaeontologist, an anthropologist, a historian and a GIS expert over a total of 10 days, and was budgeted at a very modest ETB 85,476.60 (see Annex 12.2).

MoWR informed the Consultant that funds for this work were not available and that in any case the MoWR is unable to commission civil servants to carry out surveys.

The Consultant recommended that this *impasse* might be overcome by scheduling the ARCCH survey for the start-up phase of construction, and implementing it through the Supervision Consultant.

Dec. 2010: the TOR for the Management Services Contract include the ARCCH survey as a task within the Scope of Services of the contract's Activity 1.

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## 9.6 APPENDIX 1 - GPS RECORDS

No.	Local name	Northing	Easting	Description
<b>Megech</b>				
1	Narna	12.25432	37.28384	Hill: rock shelter with cultural imprints on the floor and outside the shelter
2	Field near Wawa pumping station	12.26212	37.30052	Field: stone tools on surface
3	Kurtiye	12.26285	37.30242	Small hill: pottery shards and stone tools
4	Abba Taje	12.25583	37.27158	Small hill: circular holes in the rock, pot shards
5	Chehaldibi	12.27536	37.27670	Hill: circular stone structure, mounds on western side
6	Wawa Kidane Mihret	12.27456	37.26786	Church: on edge of command area, rich in pot shards
7	Dahna Gabriel	12.27642	37.25350	Church: outside command area, culturally rich (pottery)
8	Guramba Battlefield	-	-	Site of 1852 battle; exact location to be determined
9	Guramba Bata	12.34373	37.32794	Ancient church, close to the future main canal
10	Werengeb Bale Egziabher	12.32803	37.31143	Church: inside command area, south-west of Guramba
<b>Ribb</b>				
1	Ribb Dam	12.03375	38.00337	Dam site
2	Askura Gabriel	12.06460	37.92541	Modern church; in Birkute Kebele, right side of Ribb valley, highly incised ridge, eroded, small sedimentary exposures
3	Diversion weir site	12.02829	37.83543	Pasture: significant pottery remains on the surface
4a	Abba Roba Got (hamlet)	12.02704	37.83271	Pasture and fields: rich in pottery fragments and polished stones, grinding stones, on both sides of the river around the future weir
4b		12.02457	37.83379	
4c		12.02957	37.83753	
5	Abwa Iyesus	11.99435	37.70810	Church: close to the Ribb river in Fogera plain, ancient
6	Nabega Giorghis	11.98002	37.60508	Ancient church: indigenous trees, burial site of well-known persons (e.g. Alaqa Gebrehana)

Note: these locations are shown on Maps 1 and 2 in Appendix 4, respectively.

## 9.7 APPENDIX 2 - PEOPLE AND ORGANISATIONS CONTACTED

### 9.7.1 Appendix 2.1: ESIA Study Team Cultural Heritage Contacts in Addis Abeba

Name	Position / Affiliation	Contact
<b>ADDIS ABABA</b>		
<b>Authority for Research and Conservation of Cultural Heritage</b>		
Jara Haile Mariam	Director General	011-515-7630
Ephraim Amare	Director, Cultural Heritage Inventory, Impressions and Standardisation	0911-761-554
Hailu Zelleke	Head of Research	
Kebede Geleta	Archaeologist	0911-445-828
Addis Ababa University		
Dr. Mulugeta Feseha	Dean, College of Development Studies	0911-244-962
Dr. Kassaye Begashaw	Coordinator, Archaeology Unit (and former Director, ARCCCH)	
<b>Independent</b>		
Fasil Giorghis	Architect / Cultural Heritage Specialist	0114-674-072
World Bank		
Ian Campbell	Senior Economist and Cultural Resources Specialist	0911-254-179
<b>INTERNATIONAL</b>		
Prof. Lawrence Todd	Director, Laboratory of Human Paleoecology, Dept. of Anthropology, Colorado State University	00-1-307-868-2169
Prof. John Kappelman	Professor, Dept. of Anthropology, University of Texas	00-1-970-491-5110
Dr. Osbjorn Pearson	Associate Professor, Dept. of Anthropology, University of New Mexico (by email)	00-1-505-277-6692

## 9.7.2 Appendix 2.2: People Contacted during Implementation of Reconnaissance Survey

Name	Position / Affiliation	Contact
<b>ADDIS ABABA</b>		
Authority for Research and Conservation of Cultural Heritage		
Kebede Geleta	Archaeologist	0911-445-828
Dr. Kassaye Begashaw	former Director (currently Coordinator, Archaeology Unit, AAU)	
<b>BAHIR DAR</b>		
Bureau of Culture and Tourism		
Mulugeta Seid Damtew	ENIDP Regional Project Coordinator & Head, Regional Culture & Tourism Bureau	0918-340-179
Semagn W/Gabriel	Deputy Head (Amhara Region Culture and Tourism Bureau)	0918-723-436
<b>Bureau of Finance and Economic Development</b>		
Berhanu Ayichew	ENIDP Deputy Regional Project Coordinator	0918-761-428
<b>GONDER</b>		
<b>Culture and Tourism Office</b>		
Getnet	Heritage Restoration and Tourism Development Process Owner	0918-703-973
Tamirat Belay	Tourist Service Provider Inspection Officer	
<b>DEMBIA WOREDA</b>		
<b>Kola Diba</b>		
Asnakew Adane	Administrator	0918-350-205
Getachew Melese	Head, Culture and Tourism Office	0913-236-770
Nesiredin Mohammad	Tourism Development & Promotion Officer	
Names of Diocese contacts can be obtained from Getachew Melese or Nesiredin Mohammad	Dembia Woreda, Bete Kihnet (Diocese) Office (Note: an appropriate time for future meetings is the 29 <sup>th</sup> day of the month (Ethiopian Calendar))	
Berhanu Tayachew	Development Agent	0918-068-063
Chalachew Bayu	Development Agent	
<b>Gorgora</b>		
Genanaw	Owner, Wawa Horticultural Farm	
Ewasu Embiale	Guard, Wawa Horticultural Farm	
Abebe Worku	Guard, Wawa Horticultural Farm	
Zemenu Kiber	Guide with local knowledge and contacts	0918-047-731 0913-366-641
Merigeta Wolde Hawariat Zewdie	Cleric, Wawa Kidane Mihret Church (near Chehaldibi)	

Name	Position / Affiliation	Contact
<b>Guramba</b>		
Mekonnen Yirdaw	Priest, Guramba Bata Church	
Bahru Belachew	Deacon, Guramba Bata Church	
Tigab Baylegn	Farmer	
Asefa Takele	Farmer	
Mulu Haile Mariam	Elder	
<b>LIBO KEMKEM WOREDA</b>		
<b>Addis Zemen</b>		
Alebachew Delel	Administrator	
Desalegn Guangul	Deputy Administrator	
Sema Zemene	Head, Culture and Tourism Office	0918-817-579
<b>Birkute Kebele</b>		
Tadesse Baynessagn	Administrator / Chairman of the Kebele	
Ababu Molla	Development Agent	
Eniye Kassaye	Priest, Askura Gabriel Church	
<b>Ribb Dam</b>		
Molla Melkie	Field Engineer, Waterworks Construction Enterprise	
<b>FOGERA WOREDA</b>		
Molla Jember	Administrator	0918-703-012, 0584-460-106
Ayalew Zenawi	Deputy Administrator	
Kedija Kemal	Deputy, Woreda Public Relations	
<b>Abwa Kokit Kebele</b>		
Cherie Mengist	Deputy Chairman	
Bosena Abitew	Head, Women's Association "Genet Got"	
Melekegenet Yihun Ferede	Head Priest, Abwa Iyesus Church	
<b>Nabega Kebele</b>		
Melke Selam-Abba Engidaw Tegegn	Monk, Nabega Giorghis Church	
Bilata Destaw Asnakew	Elder	
<b>Ribb Gabriel Kebele</b>		
Berhan Melkie	Farmer, Addis Betekristian Kebele	
Kelemu Bizualem	Farmer, Ribb Gabriel Kebele	
Muluye Fetene	Farmer, Libo-Kemkem Agita Kebele	

## 9.8 APPENDIX 3 - ITINERARY

### Itinerary of Reconnaissance Physical Cultural Heritage Survey Party

Date	Location
06 Dec. 2009	Travel AA - Bahir Dar; overnight Bahir Dar
07 Dec.	Bahir Dar - Culture & Tourism Office; phone liaison with Deputy RPC; travel to Gonder; overnight Gonder
08 Dec.	Gonder - Culture & Tourism Office; travel to Kola Diba (Dembia Woreda); Woreda Administration, Culture & Tourism, and Clergy Offices; travel to Aberja kebele with Development Agent; Abba Taje hill; Chehaldibi hill; overnight Gorgora
09 Dec.	Wawa area - pumping station; Narna hill; Kurtiye hill; Dahna Gabriel church; Wawa K. Mihret Church with two Dev. Agents, clergy; Chehaldibi hill again; overnight Gorgora
10 Dec.	Gorgora - Debre Sina church / monastery; Abba Taje again; travel to Kola Diba; Woreda Culture and Tourism Office; travel to Guramba Bata area and church with C&T Office Head; Werengeb Bale Egziabher church; Guramba battlefield (?); overnight Gonder
11 Dec.	Travel to Addis Zemen (Libo Kemkem Woreda); Woreda Administration and Culture & Tourism Office; overnight Woreta
12 Dec.	Travel to Birkute Kebele; Kebele Administration; travel to Ribb Dam (Zaha Kebele) and reservoir area (Amstiyte Kebele of Ibnat Woreda and Gubda Kebele of Farta Woreda) with two Woreda C&T staff plus Birkute Kebele Chairman and DA; Askura Gabriel church and clergy; travel to Addis Zemen and then Woreta; overnight Woreta
13 Dec.	Sunday: fieldwork in Ribb command area; Shaga, Kokit & Abwa Kokit Kebeles; old Ribb channel; Abwa Iyesus church, clergy and Kebele Deputy; Woreda PR staff; Women's Association; Yifag - elders; overnight Woreta
14 Dec.	Woreta: Woreda Administration & Culture & Tourism Office; travel to Nabega Kebele; Nabega Giorghis church & clergy, with Woreda Deputy, also local elders; overnight Woreta
15 Dec.	Fieldwork at diversion weir site with guidance from local farmers; Woreta: Woreda Administration; overnight Woreta
16 Dec.	Travel to Bahir Dar; at 0830, de-briefing Regional Project Coordinator & Deputy RPC including discussion of heritage issues related to project planning and implementation; overnight Gonder
17 Dec.	Travel to AA

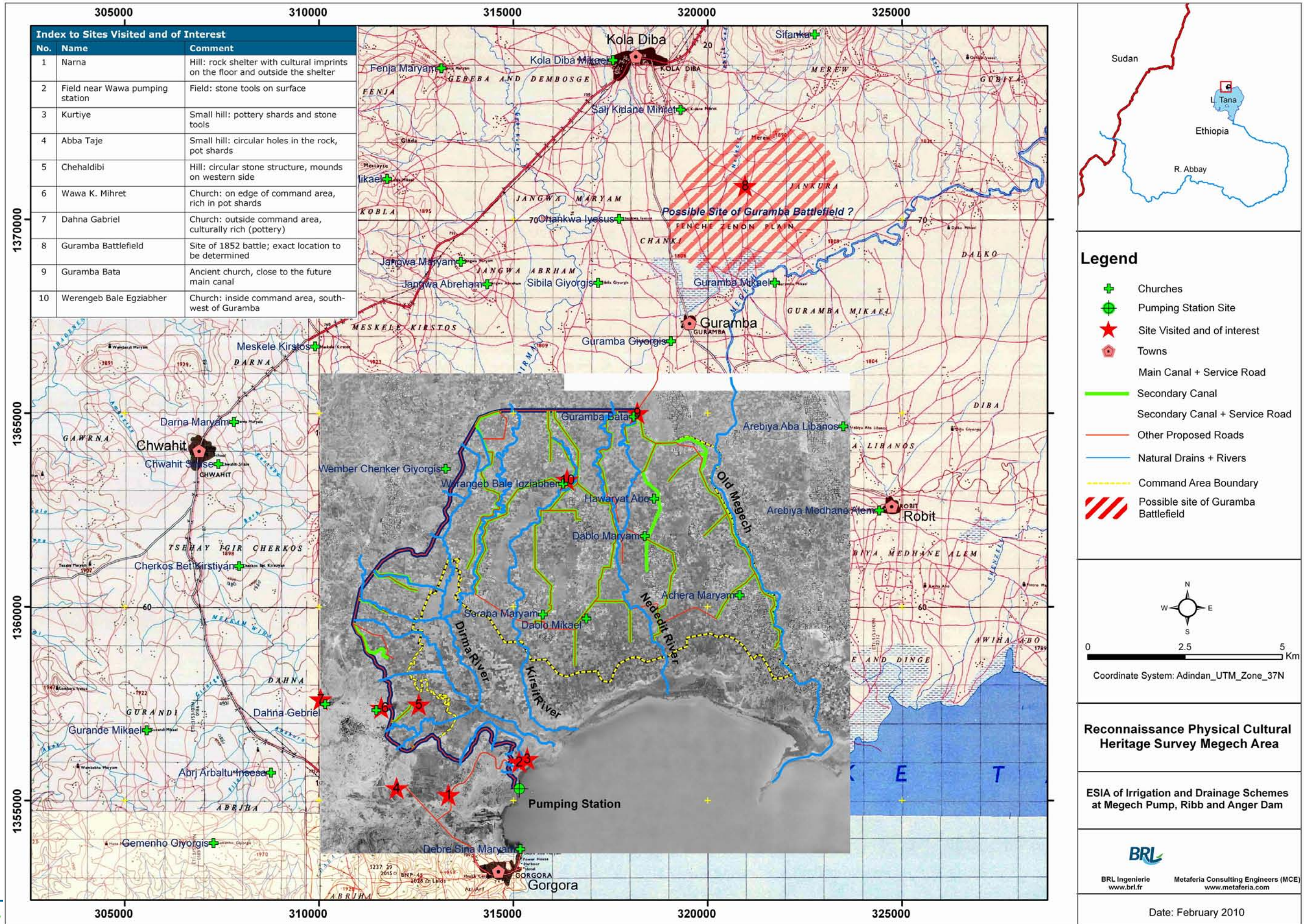
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## 9.9 APPENDIX 4 - HERITAGE SURVEY MAPS

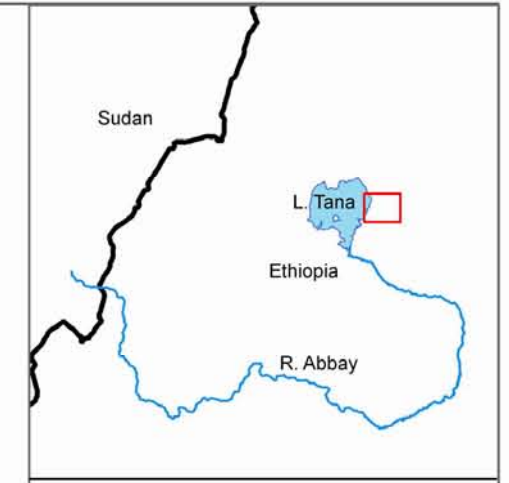
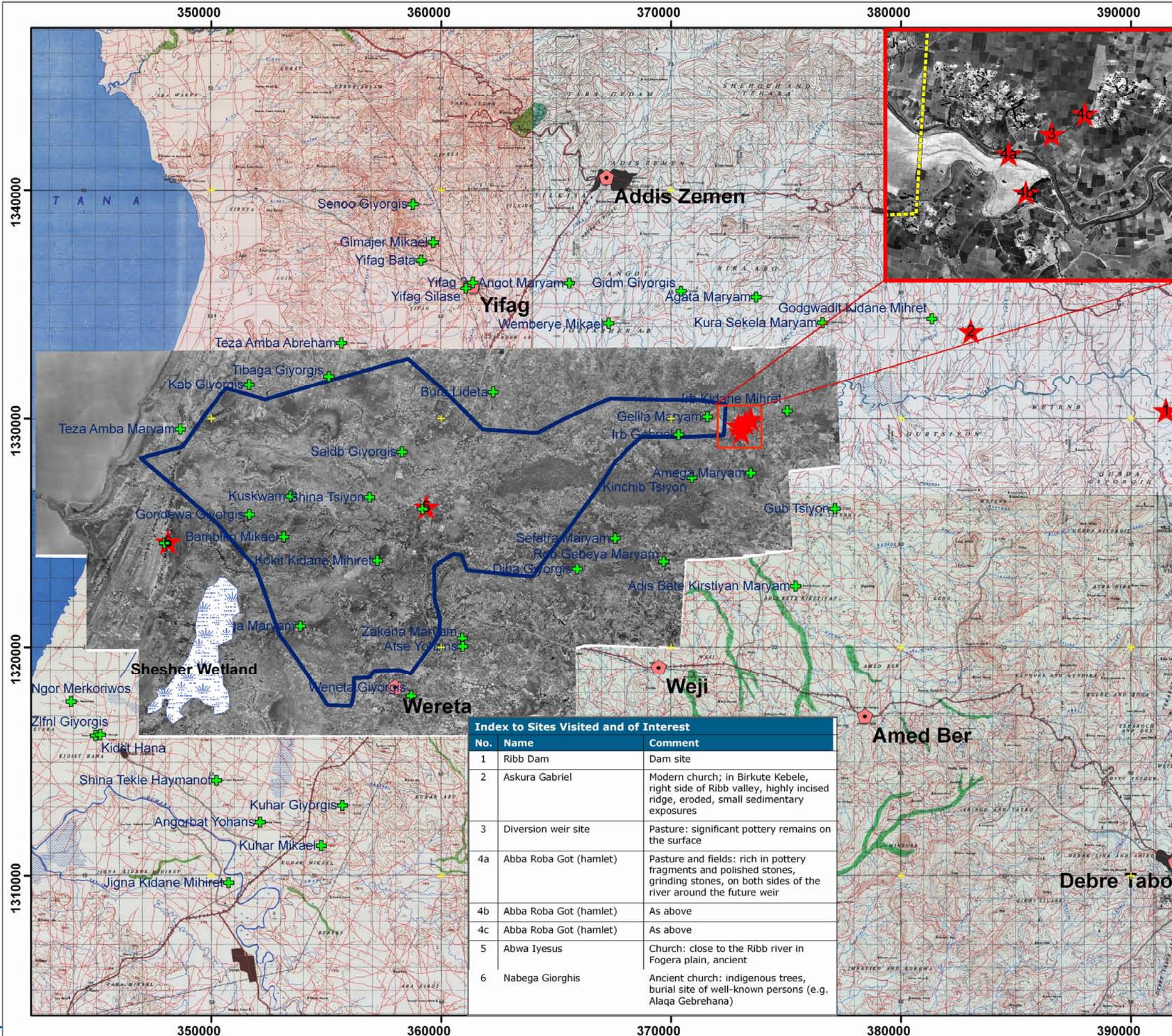
### 9.9.1 Map 1: Megech Pump (Seraba) Irrigation & Drainage Project - Sites Noted in Heritage Survey

### 9.9.2 Map 2: Ribb Irrigation & Drainage Project - Sites Noted in Heritage Survey



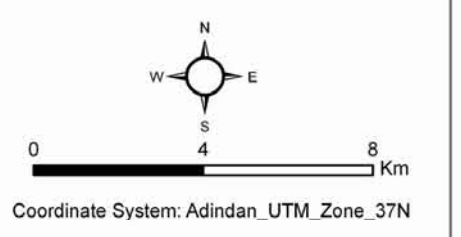






**Legend**

- + Churches
- ★ Site Visited
- Towns
- Command Area Boundary
- Wetland



**Reconnaissance Physical Cultural Heritage Survey Ribb Area**

ESIA of Irrigation and Drainage Schemes at Megech Pump, Ribb and Anger Dam

BRL Ingenierie [www.brl.fr](http://www.brl.fr) Metaferia Consulting Engineers (MCE) [www.metaferia.com](http://www.metaferia.com)

Date: February 2010



## 10. Annex 10 - Recommendations for Tender Documents

Construction and initial operation of the project is subject to two major contracts:

- Construction and commissioning of the physical works, estimated at a total period of 3 years.
- Construction supervision (3 years), followed by operation and maintenance (O&M) of the off-farm aspects of the scheme (primary and secondary irrigation infrastructure, service roads etc.), and support for Water Users Associations (WUAS) for a period understood to be 5 years.

Both contracts will be tendered internationally, and both are subject to the procurement rules of the project's international sponsor, the World Bank.

This Annex provides guidance on environmental and social topics which should be considered for incorporation into the respective contracts. It also provides an example checklist for good "housekeeping" on construction sites.

### 10.1 CONSTRUCTION SUPERVISION AND O&M CONTRACT

The construction supervision and O&M contract does not fit the form of the Bank's standard bidding documents, so special documents are in preparation.

In order to protect the sensitive environment, accelerate the flow of benefits and to establish a high-quality example for other schemes to follow, it is recommended that the following points should be included in these documents:

**Information for Bidders:** interested parties should be informed as to the general environmental and social sensitivity of the area (important wetlands adjacent to Lake Tana, very traditional local culture). Specific sensitivities include, for example:

- Access to land / land reallocation.
- Prehistoric and historic heritage features.
- Seasonal fish migrations up main rivers.
- Seasonal presence of endangered migratory birds in wetlands.
- A high number of culturally important holidays, festivals and days of rest.
- Poverty, suspicion of outsiders, and unequal gender relations.

**Health & Safety:** due to existing low standards, high sensitivities and international financing and bidding, Health & Safety should be prioritised during both construction and operation. This will require a proactive approach with a considerable training element on site, and in addition will require the establishment of a system for evacuation of casualties to appropriate medical facilities. It will also require the establishment and implementation of an effective HIV/AIDS prevention programme, in accordance with the Bank's standard requirements.

**Environmental Protection:** the sensitivities of the site and proximity to water of all operations necessitates the application of high standards of environmental protection on site. In addition to ensuring compliance with the provisions of the construction contract (see Annex 10.2), there are many aspects of system O&M that should be covered by environmentally sensitive standard operating procedures (SOPs: see Point 15 below).

**Quality Standards:** in response to the environmental and social sensitivities and to meet international best practice, it would be appropriate to require the bidders to be ready to establish certified QA systems:

For environmental protection, an Environmental Management System (EMS) in accordance with ISO 14001 or the European Union's EMAS.

For social accountability, a system taking account of the ISO standard on Social Responsibility (ISO 26000)).

**Resources for HSE Supervision during Construction:** the construction contractor will be required to comply with extensive health, safety, environment (HSE) and labour welfare provisions. A key element in obtaining practical compliance with these provisions will be the attitude and resources of the supervision consultant. These topics are almost always given second priority on construction sites unless the supervision consultant is directed to give them a higher priority by the Employer (leadership), and is resourced to do so (staff-months). Construction of MPIDP is a small contract (USD 20-25 million) but in a sensitive location and involving, directly or indirectly, large numbers of people. Under these circumstances it is recommended that the supervision consultant be resourced for (i) an international HSE specialist for a minimum of 6 months, and (ii) a full-time national HSE officer. The role of the international specialist would be (a) to ensure that, at the beginning of the contract, the construction contractor develops and implements effective HSE plans and practices, (b) to train and empower, on the job, his national colleague, and (c) to reinforce his national colleague by short repeat visits throughout the construction period.

**Bid Evaluation:** the environmental and social quality of the bids should be included in the bid evaluation process, with points awarded.

**Cultural Heritage:** as a specific task prior to contractor mobilisation on site and the associated earthworks, the supervision consultant could commission the cultural heritage survey proposed by the ARCCCH and facilitate the project's response to the survey findings (see Annex 12.2 for the survey proposal).

**Fish passage:** as a specific task prior to approval of the relevant detailed designs for construction, the supervision consultant could be asked to undertake a specialised review of the design of the cross-drainage siphons, fords etc. with respect to fish passage. Outline TOR for this task are provided at Annex 12.1.

**PMP Phase 2:** as a specific task during construction, the supervision consultant could be asked to prepare a Phase 2 Pest Management Plan. Outline TOR for this task are provided at Annex 12.3.

**Additional crossings:** as a specific task during construction, the supervision consultant could organise and implement a consultation programme with kebeles to identify optimal additional crossing points and crossing types (mainly for pedestrians and livestock). These could then be built by the construction contractor as day works or at unit rates.

**Scheme Start-up:** the practicalities and issues surrounding support to farmers after construction starts and before the water flows are challenging and will need very close coordination between all project partners. This point should be emphasised in the tender documents and a credible response requested as part of the bid.

**WUA Support:** the creation and training of democratic, effective and transparently-run WUAs and their sub-units (Water User Clusters and Water User Basic Units, respectively WUCs and WUBUs) will be a major task. As noted in the impact analysis (Chapter 5, Section 5.4.10.1), the supervision and O&M consultant will require a deep understanding of local social dynamics as well as the more usual technical irrigation and organisational skills in order to have any chance of succeeding.

**O&M - Weed Control:** the project will develop and implement an Integrated Pest Management Plan (see Annex 8 and Annex 12.3). This will apply to scheme O&M by the contractor, who will have to develop procedures for weed control which do not involve the use of herbicides. This requirement will also apply to WUAs advised by the contractor, who may be tempted to use herbicides for weed control in channels on-farm.

**O&M - Fisheries/Aquaculture:** during scheme operation there may be a need to consider water management in relation to canal and night-reservoir fisheries (aquaculture: see Annex 12.4). The contract should make clear that the O&M contractor must actively facilitate such practices.

**O&M - Standard Operating Procedures:** the contractor should be required, as part of his EMS, to develop and implement standard operating procedures for (SOPs) for O&M tasks such as weed clearance and channel profile maintenance, including notifications to WUAs and land users, working in water, weed and spoil disposal, etc. SOPs should also cover equipment maintenance, waste management and disposal and all the other normal processes and activities necessary for running the scheme.

**O&M - Clearance before Earthworks:** during O&M (as during construction) there will be a need to obtain clearance from the appropriate authorities before any earthworks (for example, the extension of borrow pits for obtaining road surfacing materials) because of (i) land users, (ii) possible ecological issues, and (iii) the potential for unknown physical cultural heritage in some areas.

**O&M - Labour-intensive Methods:** the O&M contractor should be required to actively consider the local labour situation before determining whether to use mechanised or labour-intensive methods. The project's intensified agriculture will increase labour demands for individual families. It would not be appropriate to draw labour away from the family farm for scheme O&M. However, the population is large, the younger generation are landless, and everyone needs cash. One further factor to consider is that in the command area increased exposure of workers to soil and water creates specific occupational health risks - mainly schistosomiasis and helminth transmission.

**O&M - Bridges:** the contract should clarify who is responsible for all bridge structures, including project-constructed footbridges.

**Legal Status:** what will be the legal status of the O&M contractor with respect to liability, for example if water is not supplied, if a worker or member of the public has an accident, etc.? This should be clarified in the contract (and, of course, it will also affect the insurance required).

**Monitoring:** the O&M contractor is likely to be in the best position to elaborate and implement the necessary physical monitoring programmes:

Soil and water quality - essential for tracking parameters such as soil salinity (this would cover water quality (e.g. lake water, irrigation water, drainage water, return flows in rivers); groundwater depth and quality; and standard soil parameters with respect to secondary salinisation).

Standard performance parameters - water volumetric measurements in canals, pump running time, etc.

Climate (rainfall, temperature, humidity, sunshine, windspeeds, evaporation) and soil moisture - for providing scheduling advice to WUAs.

**Additional Services:** as an international commercial organisation, the O&M contractor is likely to be better resourced and qualified than many elements of the government agricultural extension system in the future command area. The scheme will require a very significant level of service provision if it is to develop as rapidly as planned (see Chapter 5 of the Main Report, specifically Section 5.4.10). The contract should clarify whether there will be any incentives for (or restrictions on) the supervision and O&M entity to provide services outside the contract, either as a contractor (fee for service), or as a private venture (entrepreneur).

**Additional Tasks:** MoWE may wish to add additional tasks to the contractor's duties (for example, acting as an institutional home for the recommended Lakeshore Restoration Pilot Project: see Annex 12.5). The contract should allow for such eventualities.

## 10.2 CONSTRUCTION CONTRACT

The scheme's physical works have been designed by an engineering consultant (TAHAL - CECE), who is also preparing the tender documents. Construction will be carried out by a contractor selected by international competitive bidding (ICB) in accordance with the World Bank's rules for procurement of works.

The Bank's Standard Bidding Documents for Works (SBD-W)<sup>18</sup> have a specific format, agreed between many of the multilateral development banks and based on the well-known standard documents developed over the years by the International Federation of Consulting Engineers (FIDIC).

In relation to environmental and social management, key points to note in the latest revisions of the SBD-W are:

As usual, the General Conditions (GC) are overridden by the Particular Conditions (PC). The PC are prepared by the Employer (the project proponent, i.e. MoWR). The PC have two parts, Part A, Contract Data, and Part B, Specific Provisions. Part B is one location in the documents where they can be adapted to the special conditions of the project.

The General Conditions include a set of standard "social clauses" (Sub-Clauses 6.1 through 6.22). Specific minimum standards to implement the social clauses are to be detailed as part of the Specifications, with corresponding entries in the Bill of Quantities.

<sup>18</sup> Available as a download from the World Bank website. The latest version of the "Standard Bidding Documents, Procurement of Works & User's Guide" is dated May 2006, revised March and April 2007.

In the General Conditions, Sub-Clause 6.7, Health and Safety establishes significant new requirements in relation to HIV/AIDS awareness and prevention measures to be implemented by the contractor.

The preparation of tender documents is a major task. Their adaptation to specific environmental and social circumstances is also a major task, requiring access to the full set of draft documents and close interaction with the project proponent (on points of principle) and with the contracts engineer and quantity surveyor in relation to specific wording and to inclusion of items in the Bill of Quantities.

The following notes (Table 10-1) cover key points that should be considered by the Contracts Specialist responsible for preparing the tender documents when reviewing and finalising the text and items for the Particular Conditions, Specifications (especially Works Requirements) and BoQ.

Note 1: reference should also be made to the ESMP in the Main Report, specifically the two tables "ESMP for MPIDP: Pre-Construction Phase" and "ESMP for MPIDP: Construction Phase". These list numerous specific measures to be undertaken by the Contractor which should, therefore, be described in the tender documents.

Note 2: the ENIDP's Environmental and Social Management Framework (ESMF) contains sample "environmental contract clauses" in its Annex C. These are generic, and mostly not suitable for direct inclusion in the tender documents for the MPIDP.

**Table 10-1: Points Recommended for Inclusion in the Tender Documents for the Construction Contract\***

\* These points should be developed into correct contractual language with appropriate linking Specifications and BoQ items.

Reference in Standard Bidding Documents	Comment
<b>Section IV. Bidding Forms</b>	
<b>Bill of Quantities</b>	
<b>Bill No. 1: General Items</b>	It is important that a number of the key environmental, social and health and safety provisions in the contract are included as pay items in the BoQ. This provides a financial incentive for good contractor performance, and also a financial stick to promote compliance if performance is unsatisfactory. Spreading the cost of measures such as health and safety over all the other itemised works in the BoQ is <i>not</i> recommended.
<b>Section VI. Works Requirements</b>	
<b>Specifications</b>	
<b>Note:</b>	In addition to the requirements for Specifications noted below (and others as required by the SBD-W and in the ESMP), the Specifications should include: <ul style="list-style-type: none"> <li>• Design of all structures on vertisols to resist heave (movement and cracking caused by shrinking and swelling of the soil).</li> <li>• Planting and plant care methods for erosion control and bank stabilisation, including the use of only approved seeds, seed mixtures and plant materials, and favouring the use of vetiver.</li> <li>• Avoiding all work in the main rivers during the upstream movement of migratory fish (onset of high flows, around June), and in all wetlands used by migratory birds, potentially for breeding (near and at mouth of river Dirma, dry season).</li> <li>• Use of blasting blankets.</li> <li>• Use of directional security lights at night to minimise scatter and night bird disorientation.</li> </ul>
<b>Section VII. General Conditions (GC)</b>	
<b>4. The Contractor</b>	
<b>4.4 Subcontractors</b>	Although the Contractor is responsible under his contract for HSE and labour welfare, it is important to ensure that these provisions formally apply to all his subcontractors as well. This can be done through the Particular Conditions (PC).

Reference in Standard Bidding Documents	Comment
<b>4.8 Safety Procedures</b>	<p>At (a) this Sub-Clause requires the Contractor to comply with all applicable safety regulations.</p> <p>This requirement is unlikely to result in the actual implementation of good practice on site, and must be strengthened. This could be done by an amending clause in the PC, cross-referenced to a Specification (which is required in any case for the corresponding Social Clause, 6.7).</p> <p>At (e) this Sub-Clause covers Temporary Works needed for the protection and use of the public and land users.</p> <p>This requirement should be strengthened to cover the specific issues of human and livestock access across the many new channels: the Contractor will need to provide temporary bridges until the permanent bridges are built, and the issue of damage to channel banks (sideslopes) by livestock must be covered.</p>
<b>4.10 Site Data</b>	<p>This Sub-Clause requires the Employer to make all relevant data available to the Contractor, "including environmental aspects".</p> <p>In view of the special sensitivities of the project site, it is strongly recommended that bidders should be provided with a good description of the environment in which they will be working. This is often done through a specialised chapter on environmental and social conditions in a volume entitled "Information for Bidders". The structure of the SBD-W does not allow for such a volume, so in this case it is recommended that bidders be provided with the ESIA and RAP reports.</p>
<b>4.13 Rights of Way and Facilities</b>	<p>This Sub-Clause transfers all risk and cost for additional rights of way or facilities outside the Site to the Contractor.</p> <p>It is important that "the Site" is defined so as to include all locations used by the Contractor and his major suppliers including borrow pits and quarries, so that the HSE provisions can be enforced at these locations as well.</p> <p>It is also important that the Contractor is required to obtain appropriate formal clearance before using any additional land (in case of social, environmental or archaeological sensitivities).</p>
<b>4.14 Avoidance of Interference</b>	<p>This Sub-Clause focuses on public rights of way, but could be interpreted more widely.</p> <p>The Contractor's operation will interfere with existing land uses, access and (probably) water supplies. For example, construction of new canals and drains may cut or divert water currently used for dry season irrigation, or water required for construction purposes (e.g. dust control) may be pumped from scarce surface supplies, reducing volumes available to farmers. The respective rights of the public and the Contractor need to be clarified (Water is also considered under Sub-Clause 4.19).</p>
<b>4.15 Access Routes</b>	<p>This Sub-Clause confers responsibility for access and access route maintenance to the Contractor. Key points to consider and include in the PC as an amendment and with details in the Specifications are:</p> <ul style="list-style-type: none"> <li>• It is important that the Employer is empowered to control the routes used by the Contractor, to avoid potential harm to settlements and/or sensitive locations such as wetlands. This Sub-Clause should be amended in the PC and supported by a Specification covering identification, approval and use of access routes (possibly as a Method Statement).</li> <li>• This topic also links to construction traffic: the Employer must be empowered to control driver behaviour (especially speeding) both on and off Site.</li> <li>• The topic of navigation and boat access should be covered: the project involves construction at the edge of and in Lake Tana.</li> </ul>

Reference in Standard Bidding Documents	Comment
<b>4.17 Contractor's Equipment</b>	The project area is at risk from invasive species. The ESIA identifies complete cleaning of mud adhering to all construction equipment from outside the Lake Tana basin, at a location outside the basin, as the most effective preventive measure. However, this is unlikely to be feasible. Equipment should, at least, be inspected when it arrives on site and any muddy machines (small to large) pressure-washed on a concrete pad with all sediment filtered out of the runoff and deeply buried (below germination level) at an agreed location, or incinerated. This process must be specified.
<b>4.18 Protection of the Environment</b>	<p>This Sub-Clause requires the Contractor to take "all reasonable steps" to protect the environment, and to ensure that emissions and discharges do not exceed values stated in the Specifications or prescribed in Law.</p> <p>These requirements are so general as to be meaningless, especially since Ethiopia has few environmental quality standards. This clause requires amending in the PC, with a reference to the Specifications. These need to be developed to cover at least the following topics:</p> <ul style="list-style-type: none"> <li>• Environmental Management System (in line with ISO 14001) with practical Environmental Protection Plan for implementation on site.</li> <li>• Avoidance of <i>all</i> discharges to the water environment, except surface drainage of natural water.</li> <li>• Waste Management - solid and liquid (including waste separation, recycling and disposal by approved methods at approved locations, oil separators at workshops, impermeable parking areas for all equipment and vehicles (to avoid oil contamination of soils, sanitation for camps, etc.).</li> <li>• Use of standard best practice precautions and procedures - for example, secondary containment of all bulk fuel stores, drip trays under pumps, specific procedures for refuelling from bowsers, dust control.</li> <li>• Emergency Procedures - procedures, equipment and training of personnel to deal with spills (a) to land (e.g. soil contaminated by diesel spills), and (b) to water (more serious since harder to contain or remediate).</li> <li>• Working in and near Water - procedures for minimising the risk of water pollution, using standard international best practices.</li> <li>• Fish Passage - the PC need to incorporate the specific topic of fish passage; outline TOR for a review of the design of all fords, Irish (vented) fords, culverts and siphons to ensure compliance with best practice for fish movement upstream are presented at Annex 12.1; this task would best be carried out by the Supervision Contractor; the construction tender documents should allow for reaction to the review's findings and instructions (i.e. possible modifications to the designs and specific construction techniques).</li> <li>• Wetlands and Wildlife - strict avoidance of all activities outside the formal boundaries of the site, especially in wetlands, plus a formal ban on approaching or disturbing wildlife, focusing on (a) migratory fish, (b) migratory birds, specifically but not exclusively Cranes, (c) hippopotamus, and (d) python (see also 4.23).</li> <li>• Site restoration (see also 4.23).</li> <li>• Staffing provisions, training, incentives and enforcement measures.</li> </ul>
<b>4.19 Electricity, Water and Gas</b>	In relation to water, supplies are scarce and of poor quality in the dry season. Water for the main camp at the pump station can be obtained from the lake. Obtaining water for other camps and locations may be difficult. This Sub-Clause should be modified in the PC to require that the Contractor does not interfere with existing water users in any way (see also 4.14).

Reference in Standard Bidding Documents	Comment
<b>4.23 Contractor's Operations on Site</b>	<p>This Sub-Clause needs strengthening with a PC and Specification covering:</p> <ul style="list-style-type: none"> <li>• Limits of the Site (see also 4.13 and 4.18).</li> <li>• Restoration of the Site prior to completion.</li> <li>• Siting, working and restoration of borrow pits and quarries.</li> <li>• Siting, management and finishing of spoil disposal sites.</li> <li>• Cross-reference to the provisions under 4.18.</li> </ul>
<b>4.24 Fossils</b>	<p>The project is in an area of both known and suspected interest for physical cultural heritage (historical and prehistoric artefacts). This Sub-Clause requires strengthening with a PC and Specification reflecting the outcome of the additional survey determined to be necessary by the responsible national authority (the Authority for Research and Conservation of Cultural Heritage, ARCCCH) on the basis of the ESIA's reconnaissance survey (see Annex 9 and Annex 12.2 of this report).</p> <p>The Specification should cover:</p> <ul style="list-style-type: none"> <li>• Locations strictly off-limits to earthworks (e.g. Narna Hill, Kurtiye Hill, Abba Taje Hill, Chehaldibi Hill, Choa Terrara).</li> <li>• Other areas off-limits to earthworks, as found by the ARCCCH survey.</li> <li>• The Employer's right to include heritage (archaeological) skills in the site supervision team, and his powers to issue stop orders (through the Engineer).</li> <li>• Chance find procedures.</li> </ul>
<b>6. Staff and Labour (the "Social Clauses")</b>	
<b>Note:</b>	<p>The User's Guide to the bidding documents states that "Specific minimum requirements for "social clauses" are to be detailed as part of the Specifications at a level equivalent to the local norms, if they exist and at a level according to the country's regulations, or to minimum requirements when no local regulations exist." (User's Guide, p92).</p> <p>Given the challenges of accessing comprehensive Ethiopian labour law and regulations for an English-language contract, in this case it is highly recommended that minimum requirements are established in the Specifications and then cross-checked for conformance with national legislation.</p> <p>Construction of the MPIDP could be an excellent starting point for introducing modern methods of ensuring social responsibility, in this case by requiring the Contractor (as well as the Engineer) to establish and implement a social accountability system taking account of the new ISO standard on Social Responsibility (ISO 26000).</p>
<b>6.1 Engagement of Staff and Labour</b>	<p>This Sub-Clause covers employment. If the RAP study has determined that certain categories of project-affected people (PAPs) should receive preferential offers of employment as part of their compensation and support packages, then this Sub-Clause will require amendment and an appropriate wording placed in the PC.</p> <p>If the RAP has not done so, then in any case the same recommendation is made here: to maximise local benefits and minimise social unrest, members of the most seriously affected households should be given first choice of refusal for construction employment for which they are qualified (in almost all cases this will be as unskilled labour, or possibly as guards).</p> <p>This requires close cooperation between the Employer and his RAP consultant, who have the names and categories of PAPs, and the Contractor, who has his labour demands and procedures.</p> <p>The numbers of PAPs, as opposed to workers from elsewhere, should be included in the Contractor's monthly reporting (see Sub-Clause 4.21).</p> <p>There is no additional cost to this process except management time, and many benefits. However, to be possible, it must be included in the tender documents by appropriate amendment of this Sub-Clause.</p>



Reference in Standard Bidding Documents	Comment
<b>6.2 Rates of Wages and Conditions of Labour</b>	<p>This Sub-Clause permits the Contractor to pay wages and observe conditions of labour not lower than the general level in the local construction industry. It is strongly recommended that the project establish conditions of labour higher than observed local norms, since these are not acceptable on an internationally-funded project.</p> <p>This could be done through application of a social accountability system in line with ISO 26000, and including such standard components as:</p> <ul style="list-style-type: none"> <li>• Corporate Social Responsibility Policy.</li> <li>• Workers' Code of Conduct.</li> <li>• Workers' grievance mechanism.</li> <li>• Provisions for welfare on site - changing facilities, rest areas, washing areas, drinking water, shade, sanitation.</li> <li>• Mechanisms for establishing and maintaining good community relations.</li> </ul> <p>This would require amendment through the PC and a supporting Specification.</p>
<b>6.5 Working Hours</b> <b>6.18 Festivals and Religious Customs</b>	<p>Sub-Clause 6.5 states that "no work shall be carried out on the Site on locally recognised days of rest ..." except as stated in the Contract.</p> <p>Sub-Clause 6.18 requires the Contractor to respect the Country's recognised festivals, days of rest and religious or other customs.</p> <p>These requirements require modification to cover the specific circumstances of the project area: clearly the Contractor will wish to work for 6 or 7 days per week, especially during the dry season when most work must be carried out. Ethiopian labour law insists on 24 hours of uninterrupted rest per worker per week and there are 12 official national holidays - but this is very little compared with local norms - there are nearly 200 religious holidays or festive days per year, not including Sundays (see Chapter 4 of ESIA Main Report).</p> <p>Considering the recommendation to maximise local employment (see 6.1 above), these customs will be a major factor in labour availability. Consequently it is recommended that both these Sub-Clauses are amended to provide for a local process which will develop agreed days of work, following negotiation with the religious authorities in the immediate area.</p>
<b>6.6 Facilities for Staff and Labour</b>	<p>Considering the lack of local facilities, it is clear that the Contractor will have to establish living accommodation for the skilled and semi-skilled members of his staff (unskilled can be recruited locally). A Specification will need to be developed to cover the standard of housing and related facilities (e.g. canteen) for both the Contractor's personnel and the Engineer and Employer's staff.</p> <p>Advance consideration should be given to the design and standard of construction of these facilities: they might be extremely useful to the local community (Wawa, Gorgora etc.) for government administration, or as a school, clinic, training centre etc. This is especially true if they are designed to be low-cost in terms of services (e.g. natural air conditioning by shade, cross-ventilation and insulation, solar-voltaic lighting and water pumping, passive solar water heating, dry composting toilets).</p>
<b>6.7 Health and Safety</b>	<p>This Sub-Clause requires a significant supporting Specification covering a number of items that should also be included in the BoQ. Specific topics / issues are:</p> <ul style="list-style-type: none"> <li>• Medical staff: should there be a doctor on Site 24-hours per day throughout the Contract? The Project's construction activities are relatively low risk (no tunnelling, no deep excavation, no major buildings or steelwork), but the area is remote and there are no emergency care facilities in the vicinity. Considering the potential for accidents, the time required to obtain care, the (probable) large numbers of unskilled workers, the need to carry out health checks, and the need to design and implement a significant HIV/AIDS programme (see below), it is recommended that the Contractor be required to provide a full-time qualified medical practitioner, with supporting nursing staff (as needed).</li> </ul>

Reference in Standard Bidding Documents	Comment
	<ul style="list-style-type: none"> <li>• Ambulance service: an ambulance is required (a) to take casualties to the project's sick bay for stabilisation, and (b) to evacuate casualties by road to hospital (Gonder, Addis Zemen, Bahir Dar, or Addis Ababa). A 4WD ambulance is essential, with driver, telecommunications links, and trained paramedic.</li> <li>• First aid: either the Accident Prevention Officer (who may be a combined Health, Safety and Environment Officer) or the Medical Officer must be able to deliver (or supervise delivery of) first aid training to workers, so that in each group of a maximum of 30 workers at least one is trained in first aid. First aid equipment must be readily available (not locked) in all vehicles and at all job sites.</li> <li>• Health and Safety measures: the Contract should specify how health and safety is to be approached and managed by the Contractor. On internationally-funded projects it is normal to do this through a Health and Safety Plan, comprising (at a minimum) the H&amp;S policy, emergency procedures and contacts, Standard Operating Procedures for various types of work (at a height, excavations, over water, etc.), the use of Risk Assessments, the use of personal protective equipment (PPE), a training programme, and methods of record-keeping.</li> <li>• HIV/AIDS prevention: the Bank's General Conditions, which "shall not be modified", impose a number of requirements on the Contractor concerning HIV/AIDS. These include (i) an awareness programme delivered by an approved service provider, (ii) condoms for all Site staff and labour, (iii) screening, diagnosis, counselling and referral of all Site staff and labour, and (iv) an "alleviation programme" for Site staff and labour and their families with respect HIV/AIDS and other STDs. The awareness programme includes local communities as well as Site staff and labour and truck drivers.</li> </ul> <p>Full development of the Health and Safety Specification, and its costing, should be carried out by a qualified specialist.</p> <p>Note: reference should be made to the detailed RAP for the MPIDP since this will include a 'feasible action plan' for preventing the spread of HIV/AIDS during construction.</p>
<b>6.11 Disorderly Conduct</b>	The definitions provided in this Sub-Clause should be extended to include disturbance of wildlife.
<b>6.14 Supply of Water</b>	The Specifications should include standards for the drinking water to be provided to Site staff and labour (the WHO standards are recommended).
<b>6.15 Measures against Insect and Pest Nuisance</b>	Insecticides used by the Contractor as a precaution against insect and pest nuisance and dangers to health should comply with the provisions of the project's Pest Management Plan: certain insecticides should not be used since they are too harmful to beneficial insects, wildlife or aquatic organisms.
<b>6.21 Prohibition of Harmful Child Labour</b>	The legal minimum age of a worker in Ethiopia is 14 years. The minimum established by the relevant ILO Convention is 18 years. In Ethiopia, regulations require that workers between the age of 14 and 17 require special protection from any occupational hazards.
<b>7. Plant, Materials and Workmanship</b>	
<b>Note:</b>	<p>This section should be amended in the PC by the addition of Sub-Clauses which:</p> <ul style="list-style-type: none"> <li>• Ban the use of asbestos in the works in any form including asbestos-cement.</li> <li>• Give preference in procurement to materials (and services) sourced from organisations implementing formal EMS and/or CSR systems.</li> <li>• Ensure that sand is only obtained from sources with ANRS BoEPLAU and local administration approval.</li> </ul>

### 10.3 WORKPLACE HOUSEKEEPING - CHECKLIST FOR CONSTRUCTION SITES

This is an example of a checklist for construction site housekeeping (source: Canadian Centre for Occupational Health and Safety).

#### DO

- Gather up and remove debris to keep the work site orderly.
- Plan for the adequate disposal of scrap, waste and surplus materials.
- Keep the work area and all equipment tidy. Designate areas for waste materials and provide containers.
- Keep stairways, passageways, ladders, scaffold and gangways free of material, supplies and obstructions.
- Secure loose or light material that is stored on roofs or on open floors.
- Keep materials at least 2 m from openings, roof edges, excavations or trenches.
- Remove or bend over nails protruding from lumber.
- Keep hoses, power cords, welding leads, etc. from lying in heavily travelled walkways or areas.
- Ensure structural openings are covered/protected adequately (e.g. sumps, shafts, floor openings, etc.)

#### DO NOT

- Do not permit rubbish to fall freely from any level of the project. Use chutes or other approved devices to materials.
- Do not throw tools or other materials.
- Do not raise or lower any tool or equipment by its own cable or supply hose.

#### Flammable/Explosive Materials

- Store flammable or explosive materials such as gasoline, oil and cleaning agents apart from other materials.
- Keep flammable and explosive materials in proper containers with contents clearly marked.
- Dispose of greasy, oily rags and other flammable materials in approved containers.
- Store full barrels in an upright position.
- Keep gasoline and oil barrels on a barrel rack.
- Store empty barrels separately.
- Post signs prohibiting smoking, open flames and other ignition sources in areas where flammable and explosive materials are stored or used.
- Store and chain all compressed gas cylinders in an upright position.
- Mark empty cylinders with the letters "mt," and store them separately from full or partially full cylinders.
- Ventilate all storage areas properly.
- Ensure that all electric fixtures and switches are explosion-proof where flammable materials are stored.
- Use grounding straps equipped with clamps on containers to prevent static electricity buildup.
- Provide the appropriate fire extinguishers for the materials found on-site. Keep fire extinguisher stations clear and accessible.

<http://www.ccohs.ca/oshanswers/hsprograms/cklstcon.html>

## 11. Annex 11 - Terms of Reference (for this study)

### CONSULTANCY SERVICES ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF ABOUT 20,000 HA IRRIGATION AND DRAINAGE SCHEMES AT MEGECH PUMP (AT SERABA), RIBB AND ANGER DAM

#### *Terms of Reference*

11.1 INTRODUCTION .....	11-3
11.2 ENIDP IMPLEMENTATION ARRANGEMENTS .....	11-3
11.3 PROJECT DESCRIPTION .....	11-4
11.3.1 Megech Pump	11-4
11.3.2 Ribb	11-5
11.3.3 Anger Dam	11-6
11.3.4 Groundwater Development Around Lake Tana	11-6
11.4 WORLD BANK SAFEGUARD POLICIES.....	11-6
11.5 SCOPE OF WORK .....	11-7
11.5.1 General	11-7
11.5.2 Key Elements of the ESIA	11-8
11.5.3 Project Objectives, Alternatives and Description	11-8
11.5.4 Baseline Data	11-8
11.5.5 Environmental Impacts	11-9
11.5.6 Environmental Management Plans (EMPs)	11-9
11.5.7 Integrated Pest Management Plans	11-10
11.5.8 Public Consultation	11-10
11.6 DATA/INFORMATION FOR CONDUCTING THE ESIA .....	11-11
11.7 CONSULTANT QUALIFICATIONS AND EXPERTISE REQUIREMENTS .....	11-11
11.8 SCHEDULE AND DELIVERABLES .....	11-12

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<b>11.9 TECHNICAL PROPOSAL CONTENTS .....</b>	<b>11-13</b>
<b>11.10 ANNEX 1: RELEVANT SECTIONS FROM THE FEASIBILITY STUDY TOR.....</b>	<b>11-13</b>
<b>11.11 ANNEX 2: RELEVANT SECTIONS FROM THE ESMF .....</b>	<b>11-13</b>
<b>11.12 ANNEX 3: OUTLINE OF AN INTEGRATED PEST MANAGEMENT PLAN .....</b>	<b>11-21</b>
<b>11.13 ANNEX 4: EMP TEMPLATES .....</b>	<b>11-23</b>

## 11.1 INTRODUCTION

Under the Nile Basin Initiative, the Eastern Nile Subsidiary Action Program (ENSAP), which includes the countries of Egypt, Ethiopia, and Sudan, is a regional program of cooperative investment that seeks to initiate a regional, integrated, multi-purpose program through a first set of investments. The ENSAP countries have identified sub-projects in the areas of integrated water resources management, flood management, power generation and interconnection, watershed management, and irrigation and drainage. In March 2001, the Eastern Nile Council of Ministers (ENCOM) decided that funding should be sought to advance studies of promising irrigation and drainage sites to feasibility and design level. In October 2004, ENCOM decided to fast track irrigation and drainage projects to achieve clear results of Nile Basin collaboration on the ground, and agreed to feasibility studies for 100,000 ha, and investment for initial development of irrigation of around 20,000-30,000 ha, in each country.

As a consequence, the Government of the Federal Democratic Republic of Ethiopia (GoE) has agreed with the World Bank to prepare an Ethiopia Nile Irrigation and Drainage Project (ENIDP) that will finance up to 20,000 ha of new irrigated agriculture and complete detailed feasibility studies of up to 80,000 ha. The designated schemes to be financed for development by the ENIDP are Megech Pump (at Seraba) and Ribb. ENIDP will finance feasibility studies for the Anger Dam scheme, but not investment. All three schemes will depend on surface water resources. An initial assessment of groundwater resources around Lake Tana is being undertaken that will lead to an action plan for determining additional groundwater-based irrigation development option(s). Feasibility studies for irrigation development at Megech (at Seraba), Ribb and Anger Dam are being initiated for completion in mid 2008. They include substantial environmental and social analyses to both inform the planning and design of the schemes, and to provide detailed information for subsequent Environmental and Social Impact Assessments (ESIAs) (See Annex A). A separate fisheries study of Ribb River is also underway.

The selection of the irrigation schemes to be included in the ENIDP is the result of a strategic analysis of potential irrigation developments in the Ethiopian Nile Basin completed for the MoWR in July 2006<sup>19</sup>. This analysis evaluated the relative attractiveness of nine potential schemes based on technical, cost, environmental and social criteria. Based on this analysis, the MoWR selected the schemes to be included for financing and/or study by the ENIDP.

An Environmental and Social Management Framework (ESMF) and a separate, stand-alone Resettlement Policy Framework (RPF) for the project have already been prepared. The ESMF has defined roles, responsibilities and procedures for the preparation, review and approval of ESIs for each of the above ENIDP schemes once their designs are reasonably advanced. The ESMF also includes substantial discussion of the kinds of adverse impacts that ENIDP investments may cause, and possibilities for their mitigation; it should be a key reference document in preparing the ESIA (see Annex B).

These terms of reference (ToR) define the scope of a consultancy to prepare an Environmental and Social Impact Assessment (ESIA) for the above mentioned irrigation investment schemes: Megech Pump (at Seraba), Ribb, and Anger Dam. Resettlement Action Plans are being prepared under separate consultancies. The Consultant will report to the Ministry of Water Resources in conducting the ESIA assignment.

## 11.2 ENIDP IMPLEMENTATION ARRANGEMENTS

This section of the ToR refers to the implementation of the Megech Pump and Ribb schemes that will be financed by the World Bank. The ENIDP will not be financing implementation of the Anger Dam development.

The ENIDP will be implemented by the Ministry of Water Resources (MoWR) and in Amhara Regional State through the different regional agencies including BoWRD, BoARD, EPLAUA, BoCP, RARI. Coordination at the regional level will be provided by the office of the Amhara regional President. Guidance will be provided by a National Project Steering Committee (NPSC) and a Regional Project Steering Committee (RPSC) at the respective levels.

<sup>19</sup> "Ethiopian Nile Irrigation and Drainage Project: Consultancy Service for Identification of Irrigation and Drainage Projects in the Nile Basin in Ethiopia". Tahal/MWH/Concert, July 2006.

The *National Project Steering Committee* will be chaired by the State Minister of MoWR with representatives from MoARD, EPA, MoFED, EIAR and the Private Sector at the federal level and representatives from the Amhara BoWRD, BoARD, BoCPs and EPLAUA and other relevant stakeholders. The NPSC will be responsible for ensuring relevant government water sector policies and the project objectives are adhered to; review and approve annual programs, work plans and budget; and monitor and evaluate the progress of the project. The Committee will meet at least twice annually.

The *Regional Project Steering Committee* will be chaired by the Amhara Regional President and will consist of the Head of BoWRD, Head of BoARD, and representatives from ARARI, BoCP, BoFED, BoTI, EPLAUA, Food Security Office and representatives of the two apex Water Users Associations. Membership will also be extended to representatives from local universities, civil society and private sector organizations (e.g. chambers of commerce) on a case by case basis. The RPSC will be responsible for overseeing implementation of the ENIDP at the regional level including the annual work plan and budget, and M&E of the progress of the project. The Committee will meet at least half-yearly.

MoWR will assign a *National Project Coordinator (NPC)* under its Irrigation and Drainage Department who will be guided and advised by the NPSC and will also serve as a secretary for NPSC. A *Regional Project Coordinator (RPC)* will be assigned within the Amhara Office of the President to coordinate project activities among the various participating regional agencies (BoWRD, BoARD, BoCP, ARARI, EPLAUA). The RPC will also liaise with participating Woredas and Kebeles. EPLAUA, in collaboration with the EPA, will be responsible for the implementation of the environmental and social safeguard activities under the project. Representatives from involved Woreda Offices of Denbia, Fogerra, Libokemkem and Gonder Zuria will form four Woreda Project Implementation Teams (WPIT) comprising of the different Team Leaders including, Extension, Water Resources, Cooperative Promotion, Inputs and Credit, and Environmental Protection; representatives from Woreda Finance; representatives of Kebele Associations, and WUAs. The WPIT will be jointly headed by the Head of WoWRD and WoARD. They will be assisted by Kebele Associations and DAs.

## 11.3 PROJECT DESCRIPTION

### 11.3.1 Megech Pump

The proposed scheme is adjacent to the northern shores of Lake Tana and straddles the Megech River near the Lake Tana shoreline. The Megech River has a catchment area of about 700km<sup>2</sup> and flows generally in a southerly direction to Lake Tana. The scheme lies south of the Gonder-Debre Tabor road, and begins at a point about 15 km north of the lake where the river breaks out of the steep canyon. It has four sub-schemes -- Seraba (5,254 ha) and Guramba (6,640 ha) to the west, and Robit (6,532 ha) and Jarjer (10,020 ha) to the east. All will be served by water pumped from the lake. Only the Seraba sub-scheme, adjacent to Lake Tana on the west, is included in this project. The three other sub-schemes may be implemented at a later date with alternate financing.

According to a previous study and a site visit (2002), almost the whole area is cultivated and used for grazing. The project area is used by some 5,500 households. The major environmental health concerns in the area are water-related diseases such as malaria, typhus, and schistosomiasis. Environmentally sensitive areas that are located close to the Megech irrigation project areas include the Megech River, Lake Tana, and a 300 ha closed wetland system. The Megech River is a small seasonal river which is used as a spawning site for Lake Tana fish species of which the dominant are *Barbus* spp., *Oreochromis* spp., and *Clarius* spp.

Preliminary indications are thus that the principal environmental and social issues that need to be addressed by the ESIA include:

- Sensitive riparian habitats along the Megech River and adjacent to Lake Tana, and a wetland within the command area, that may need protection and/or conservation;
- Lake Tana water levels and quality, and associated fish and fisheries values, that may be affected by water withdrawals for, and drainage from, the irrigation development;
- Water-related diseases within and around the irrigation development; and
- Health and environmental risks associated with anticipated increases in the use and run-off of pesticides and fertilizers.

### 11.3.2 Ribb

The 130 km Ribb River is located on the east side of Lake Tana, has a drainage area of about 1790 km<sup>2</sup> and, with its tributaries, forms a watershed on the western slope of the high mountainous area east of the town of Debre Tabor. In the low and middle reaches of the river, especially in the extensive alluvial plains bordering the lake, the river meanders and flows slowly. This results in a serious river channel deposit and overflow of riverbanks during rainy season. The project will encompass flood control, drainage, and supplementary plus dry season irrigation by gravity from the Ribb Dam, about 50 km upstream of Lake Tana, which would be used for storage and flood control. The study and design works of the dam are currently underway with Government of Ethiopia (GoE) financing. It is expected that the dam will also be financed by the GoE, while the downstream irrigation development will be World Bank-financed. The proposed irrigation area is located in the plain in the middle Ribb valley on both sides of the Addis Zemen-Wereta road, and does not extend to the Lake Tana shores. Water released from the Ribb Dam would be diverted to the irrigation sites by a weir built close the irrigation sites. The total irrigable command area identified is 19,925 ha, and the total net irrigable area on both banks of the river is 14,460 ha.

Environmentally sensitive areas include the Ribb River, Lake Tana, the Fogera Plain, and wetlands along the lake shore and within the plain, especially in and around Welela and Shesher Ponds. Wetlands on the plain may be dependent on seasonal flooding of the Ribb River. The Ribb River provides important spawning and nursery habitats for migratory fish well up into the drainage, especially the economically significant *Barbus* fish species. The Ribb Dam will block upstream fish migration, and reduce or eliminate seasonal flooding of the Fogera Plain wetlands; mitigation measures (eg. fish ladder; artificial habitat creation downstream of the dam and/or in tributaries; development of reservoir fisheries; minimum flow releases from the dam, deliberate flooding of Fogera wetlands) are indicated to avoid significant adverse impacts. The GoE is currently undertaking a fish study to determine the species of fish using the Ribb drainage, and the timing, range and type of use (e.g. spawning, rearing). Lake Tana, Fogera Plain and the associated wetlands are wintering habitat for vulnerable and threatened bird species<sup>20</sup> such as Lesser Kestrel, Wattled Crane, Greater Spotted Eagle, Lesser Flamingo, Pallid Harrier and Great Snipe, so mitigation measures to protect these wetlands may be important. Water-borne diseases are the major health threats in the area with malaria being the most important.

The population size, as projected from the 1994 census, was 39,958 in 1997, of which about 25,113 are economically active. The majority of the population belongs to the Amhara ethnic group. The gross enrollment ratio in primary education in the Ribb command area is among the lowest in the Amhara Region, estimated at about 8%. Malaria is the most reported cause for ailment, and the second is intestinal parasites. Some 33% of the population has access to clean water, which is obtained from developed springs and shallow boreholes. Boreholes supply good water to 1.4% of the population. There is no electric power supply in the command area. During the 1994 and 1997 period, 2000 households were affected by food deficit.

The ESIA will be an integrated assessment of both the Ribb Dam and the proposed downstream irrigation development. The study area thus includes the entire Ribb watershed. Preliminary indications are thus that the principal environmental and social issues that need to be addressed by the ESIA include:

- Fish and fisheries concerns, outlined above, in the Ribb River and Lake Tana;
- Wetlands along Lake Tana and within the Fogera Plain, and their associated biodiversity values;
- Potentially significant erosion above the dam site, and the need for watershed rehabilitation and passing of sediments past the dam through to the lake;
- Water-related diseases within and around the reservoir and irrigation development; and
- Health and environmental risks associated with anticipated increases in the use and run-off of pesticides and fertilizers.

The MoWR has had a preliminary ESIA prepared for the Ribb Dam; this was largely a qualitative assessment based on existing information.

<sup>20</sup> Francis, I.S., and S. Aynalem. 2007. Bird Surveys Around Bahir Dar-Lake Tana IBA, Ethiopia, 8 January to 10 February 2007. RSPB Scotland, April 2007.



### 11.3.3 Anger Dam

The Anger River, largest of the three main tributaries of the Didesa River, drains the area north and east of Nekemte. The Didesa River is the largest tributary of the Blue Nile River in terms of volume of water, contributing roughly a quarter of the total flow as measured at the Sudanese border. Anger Dam is conceived as a multipurpose (irrigation and hydropower) project, and is situated downstream of the Anger's emergence into a relatively wide, somewhat dissected valley, about 100 km from the Anger-Didesa confluence. It offers a total command area of 17,000 ha, with a net irrigable area of 14,450 ha. The Anger Dam itself is situated about 23 km upstream of the Anger River confluence with the Alatu River, controlling a drainage area of about 1,780km<sup>2</sup>.

Because of the topography of the project area, about one third of the project lands would be irrigated by gravity, the other two-thirds requiring pumping plants and canals. Irrigation facilities would consist of two gravity main canals (North and South), originating from the Anger Dam, and five pump canals, one large and three small pumping plants, a distribution system to convey the water to the farms, and drainage canals for the evacuation of excess irrigation and/or rain water. The power plant would be at the toe of the dam. Anger Dam would also be expected to regulate the flows of the Anger River to firm up the releases from a future, downstream Nekemte Dam.

The major human health concern in the Anger River basin is malaria with a prevalence rate of 5%, is the second most disease in Oromia Region. No significant environmentally sensitive areas are listed in the Abbay Master Plan Sectoral Report for this basin. A need for tsetse control programs is indicated. There is a good network of main roads throughout the zone. These state farms in the zone have a network of access roads to them which are in need of upgrading. The population density in the zone is very low, estimated at about 36 persons/km<sup>2</sup>.

The ESIA will be an integrated assessment of both the Anger Dam and the proposed downstream irrigation development. The study area thus includes the entire Anger watershed to the downstream end of the proposed irrigation scheme, plus downstream areas that might be affected by irrigation-induced changes in water quantity or quality. Preliminary indications are thus that the principal environmental and social issues that need to be addressed by the ESIA include:

- Fish and fisheries concerns above and below the dam;
- Water-related diseases within and around the reservoir and irrigation development; and
- Health and environmental risks associated with anticipated increases in the use and run-off of pesticides and fertilizers.

### 11.3.4 Groundwater Development Around Lake Tana

A rapid assessment of accessible groundwater around Lake Tana is being undertaken to help the ENIDP determine irrigation development options. It will result in an operational action plan for implementation under the ENIDP, including the identification of data gaps for further evaluation of the groundwater resources and terms of reference for a comprehensive evaluation to assess the groundwater potential, development options and management requirements. It is expected that these investigations will provide better knowledge of groundwater resources, and help the GoE consider groundwater development options in parallel to conventional surface water development options.

## 11.4 WORLD BANK SAFEGUARD POLICIES

The following Safeguard Policies apply to this project:

- OP 4.01 Environmental Assessment -- is triggered in view of the impacts of irrigation development on the environment. The feasibility studies for each scheme include environmental analysis to facilitate the development of proposals that avoid or minimize potential adverse environmental impacts (see Annex A). An independent ESIA will be needed for each scheme once their designs are reasonably advanced.
- OP 4.04 Natural Habitats -- is triggered in view of the potential impact of irrigation development on natural habitats, especially around Lake Tana. Natural habitat concerns will be addressed during the feasibility studies and then in the ESIA's.
- OP 4.09 Pest Management -- is triggered, as the project will actively promote increased use of inputs. The EMPs of each scheme will need to include an Integrated Pest Management Plan.
- OP 4.11 Physical Cultural Resources -- may be triggered. The ESIA's will include sufficient field work to determine if the policy should be triggered and detailed surveys carried out.

- OP 4.12 Involuntary Resettlement -- is triggered since infrastructure works may entail the acquisition of land owned or used by individuals or families. Resettlement Action Plans are being separately prepared for each scheme.
- OP 4.37 Safety of Dams -- is triggered since the Ribb and Anger schemes will rely on water storage facilities. MoWR is responsible for separately contracting dam safety advisers for the dams, and has already done so for Ribb. This work is not part of these ToR.
- OP 7.50 Projects in International Waterways -- is triggered as the investments may affect downstream water quantity or quality in the Nile Basin. Riparian notification is being handled through Nile Basin consultative processes by MoWR.

## 11.5 SCOPE OF WORK

### 11.5.1 General

The Consultant is required to carry out an ESIA study and prepare an ESIA report according to the World Bank standards (see OP 4.01) and those of the Ethiopia EPA. The ESIA report is to be organized, perhaps in separate volumes, to provide a stand-alone assessment and an Environmental Management Plan (EMP) for each of the three schemes: Megech, Ribb (irrigation and dam), and Anger Dam.

As mentioned above, feasibility studies for irrigation development at Megech (at Seraba), Ribb and Anger Dam are being initiated for completion in mid 2008. They include substantial environmental and social analyses to both inform the planning and design of the schemes, and to provide detailed information for the subsequent ESIA. Some other sources of information are identified in Section 11.6 below. In preparing his Inception Report, the Consultant must undertake a detailed assessment of a) what, if any, data/information gaps exist that may jeopardize successful completion of the ESIA; and b) how those gaps can be filled in a timely manner.

Without limiting the scope and content of the final ESIA, the Consultant is generally required to address the following matters:

- Alternate project plans and designs to avoid or minimize adverse impacts, and rationale for the selected alternatives;
- The main environmental effects of the proposed project, both in the project area and in the surrounding area and the timescale of the impacts;
- The size and extent of the impacts based as much as possible on quantitative data rather than qualitative assessment;
- Those groups that will benefit and those disadvantaged by the project;
- The impact on any rare species of plant or animal in the area;
- The impact on human health, and on occupational health and safety;
- The mitigating measures needed and how they should be incorporated into the project design;
- The control and management of the environmental and social aspects of the project to determine if they will be effective;
- Cumulative impacts of the project in combination with similar impacts from other planned or reasonably foreseeable projects or developments in the area; and transboundary impacts;
- The need for further baseline data collection or other specialist studies needed to refine the EMPs proposed in the ESIA;
- The present policy, institutional and legislative situation and future needs; and
- The monitoring and evaluation activities that are required to ensure that mitigating measures are implemented and future problems are avoided.

The ESIA will employ mapping at appropriate scales, and best practicable assessment tools (e.g. checklists, impact matrices or networks, overlay mapping, modeling) to describe the potentially affected environment, identify and analyze potential impacts, assess alternatives, and communicate the results in the final report.

## 11.5.2 Key Elements of the ESIA

The ESIA report will follow the general outline of EA reports as required by the World Bank (see World Bank OP 4.01, Annex B for details), and similar requirements of the Ethiopia EPA. Thus, the main elements of the report will be:

- Executive summary;
- Introduction, including the overall approach, methodologies and scope of work encompassed by the ESIA;
- Policy, legal, and administrative framework, including international conventions that Ethiopia is party to, with an emphasis on analysis of any needed measures to ensure project compliance;
- Project objectives and description, including an analysis of alternate dam sites and irrigation scheme sites and layouts, and alternate means for avoiding or minimizing adverse impacts;
- Baseline data, with a focus on key issues. Identification of significant gaps in the data/information used for the ESIA;
- Potential environmental impacts and mitigation measures;
- Environmental management plans (EMPs), including an analysis of the institutional capacity to implement the EMPs, and any training/capacity building program required to strengthen that capacity;
- Conclusions; and
- Technical appendices.

Specific aspects of the above ESIA components that should be addressed are described below.

### 11.5.2.1 Project Objectives, Alternatives and Description

This section should describe the need for the project in the context of the local and national agricultural strategy. The effect on economic and social development goals of the project area, country, and region when the project influences transboundary rivers, aquifers, coastal zones or other issues. If the project is an element of an overall irrigation and drainage or agricultural sector development program in the area, then a description of the other program elements must be presented.

A physical description of project should be provided, including the physical location and area of influence, the schedule of works and implementation program, the source of irrigation water, the disposal strategy for drainage water, and the projected effects including volume and flow rate of irrigation and drainage waters.

The description should include the alternatives considered, and an explanation of why the preferred alternatives were selected over others. Project alternatives should be clearly presented (including the 'no action' alternative). For irrigation projects, alternative sources of water and demand reduction through conservation and re-use and project management and monitoring should be considered. For drainage, alternative methods, overall project concepts and management and monitoring programs should be thoroughly analyzed.

### 11.5.2.2 Baseline Data

The key categories of data that require due attention during the ESIA include:

- Land conditions: topography, geology, soils, vegetation, land/watershed degradation
- Water conditions: hydrology and hydrogeology; water quality (chemistry), supply, demand and allocation
- Atmospheric conditions: climate, air quality
- Ecological conditions: terrestrial flora and fauna; aquatic ecology; ecologically important or sensitive habitats, including parks or preserves; fisheries; tropical disease vectors; protected areas
- Socio-economic conditions: for example, demographics; living standards; housing, energy and water supply; administrative boundaries and local governance; land use and settlement patterns; public health; economic activities; tourism; transportation
- Significant natural, cultural or historic sites

Data will be suitably presented in tables, graphs, maps of appropriate scale, etc. to support the ESIA analyses and results. As much as possible, only summary data will be included in the main report, with details in appendices.

### 11.5.2.3 Environmental Impacts

A prediction of the changes in the environment resulting from project construction and operation are to be considered, and an assessment of the effect on the surrounding physical, biological, and human systems, should be presented. The engineering design plans should reflect "best practice" in terms of construction management and operations to ensure that potential negative environmental impacts are minimized. Special consideration should also be given to the following areas:

- Land, soil and vegetation resources, and land/watershed degradation
- Water resources (quantity and quality)
- Wetlands and other natural habitats, with particular attention to fish resources
- Socio-economic, health and cultural heritage issues

The ESIA will specifically analyze potential cumulative impacts – i.e. those of the project in combination with similar impacts from other planned or reasonably foreseeable projects or developments in the area. These may include, around Lake Tana for example, full irrigation development of the Megech command area, a dam and irrigation development in the Gumera River watershed, other dams on tributaries to the lake, and the Beles Hydropower Project. The ESIA will also analyze impacts that may be transboundary in nature – e.g. extending downstream via the Abbay River to Sudan.

### 11.5.2.4 Environmental Management Plans (EMPs)

A major emphasis of the ESIA will be the EMPs it contains. The EMPs will be one element of the operational plan for each irrigation scheme as described in the ESIA (Section 11.5.2.1 above). Thus, they should contain few, if any, recommended design or operational changes. The Consultant will make all reasonable efforts to discuss such proposed changes with the MoWR for adoption into the project design before the ESIA is finalized.

The EMPs will focus on providing general and specific direction on pre-construction, construction, and operation and maintenance measures and practices to avoid or minimize adverse environmental effects that can be readily incorporated into: (a) construction specifications and drawings for inclusion in tender documents; and (b) operation and maintenance manuals. To facilitate this incorporation, the Consultant should consider a tabular presentation that, for each element of civil works, indicates the application of general and specific management measures.

The EMPs should be formulated in such a way that they are easy to use, implementable and auditable. References within the plans should be clearly and readily identifiable. Also, the main text of the EMPs needs to be kept as clear and concise as possible, with detailed information relegated to annexes. The EMPs should identify linkages to other relevant plans relating to the project, such as plans dealing with project operations and resettlement issues. The following aspects should typically be addressed within EMPs.

*Summary of impacts:* The predicted adverse environmental and social impacts for which mitigation is required should be identified and briefly summarized. Cross-referencing to the ESIA report or other documentation is recommended, so that additional detail can readily be referenced.

*Description of mitigation measures:* The EMP identifies feasible and cost effective measures to reduce potentially significant adverse environmental and social impacts to acceptable levels. Each mitigation measure should be briefly described with reference to the impact to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should be accompanied by, or referenced to, designs, equipment descriptions, and operating procedures which elaborate on the technical aspects of implementing the various measures. Where the mitigation measures may result in secondary impacts, their significance should be evaluated.

Since the project involves dams in, perhaps, degrading watersheds, and rivers that may contain important aquatic habitats and fish species, an EMP should pay particular attention to the needs for:

- watershed restoration and management;
- dam structures designed so that sediments can be periodically flushed downstream, perhaps with "design floods" to mimic natural conditions for sediment transport and fish migration;
- minimum releases of appropriate water quantities and qualities to maintain downstream aquatic habitats and water uses;
- fish passage past a dam; and
- habitat enhancement above and below a dam to sustain fish populations to at least pre-project levels.

*Description of monitoring program:* Environmental performance monitoring should be designed to ensure that mitigation measures are implemented, have the intended result, and that remedial measures are undertaken if mitigation measures are inadequate or the impacts have been underestimated within the ESIA report. It should also assess compliance with national standards and World Bank Group requirements or guidelines.

The monitoring program should clearly indicate the linkages between impacts identified in the ESIA report, indicators to be measured, methods to be used, sampling locations, frequency of measurements, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions, and so forth. Although not essential to have complete details of monitoring in the EMP, it should describe the means by which final monitoring arrangements will be agreed.

*Institutional arrangements:* Responsibilities for implementation, mitigation and monitoring should be clearly defined. The EMP should identify arrangements for coordination between the various actors responsible for mitigation. Training and capacity-building requirements for environmental considerations in project will be outlined.

*Cost estimates and sources of funds:* These should be specified for both the initial investment and recurring expenses for implementing all measures contained in the EMP, integrated into the total project costs.

For further guidance on EMPs, the Consultant should refer to the World Bank's EA Sourcebook Number 25 (January 1999). Useful templates for summarizing EMP action items are included in Annex 4 of these ToR.

#### **11.5.2.5 Integrated Pest Management Plans**

Since the project will actively promote increased use of inputs, including pesticides, the EMPs of each scheme will need to include an Integrated Pest Management Plan to meet the requirements of World Bank OP4.09. Note that pests are defined in the broad sense. In addition to agricultural insect pests and plant diseases, pests also include weeds, birds, rodents, and human or livestock disease vectors. Similarly, the FAO defines pesticides as any substance or mixture of substances:

- intended for preventing, destroying or controlling any pest, including a) vectors of human and animal disease, b) unwanted species of plants or animals causing harm during, or otherwise interfering with, production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs;
- that may be administered to animals for the control of insects, arachnids or other pests in or on their body;
- intended for use as a plant-growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit; and
- substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

The contents of an IPM Plan are outlined in Annex 3. More detailed guidance is available through the World Bank's website.

### **11.5.3 Public Consultation**

The Consultant is expected to organize and implement a public consultation program in preparing the ESIA. It will be carried out in collaboration with the MoWR and regional authorities implementing the ENIDP. The program will involve all stakeholders in the project – e.g. regional authorities responsible for land and water management, agriculture, transport, etc.; community leaders and land users in the project areas; and business people. The objectives of the program will encompass: a) informing stakeholders about the proposed ENIDP investments, and soliciting their concerns; b) involving stakeholders in further refining the definition of issues to be addressed in the ESIA, of what adverse impacts might be created, and of what mitigation approaches and measures might thus be appropriate; and c) soliciting comments on the draft final ESIA report.

In his proposal, the Consultant will describe his approach and methodology for such a consultation program, and present a budgeted workplan for the detailed design and implementation of the program. He will clearly describe the expected role of the MoWR and other ENIDP implementing agencies in the program.

## 11.6 DATA/INFORMATION FOR CONDUCTING THE ESIA

Carrying out an adequate ESIA is highly dependent on the amount and quality of the information used. In his technical proposal, the Consultant must demonstrate that he has a realistic understanding of what information exists, what will be required to conduct the ESIA, and thus what primary data/information collection is planned as part of the ESIA assignment.

The Consultant is advised that substantial environmental data/information collection and analysis is being undertaken within the feasibility studies for the three schemes (see Annex 1). In preparing his technical proposal, the Consultant should obtain a full briefing from the MoWR on what this work consists of, and what data/information and analyses will be available to the ESIA team. Note that for the Ribb development, the feasibility study encompasses just the irrigation development and does not include the Ribb dam and reservoir. MoWR has had a preliminary ESIA prepared for the Ribb Dam that did not include any primary data collection. Thus, the Consultant may need to undertake primary data/information collection himself.

The Consultant is also advised that the MoWR has contracted a fisheries study for the Ribb River that will provide data on fish and fish habitat and use in the Ribb watershed, as well as the extent of dependent fisheries in the river and Lake Tana.

Other potential sources of information include:

- In preparing the Tana Basin Integrated Water Resources Development Project, the MoWR is carrying out a hydrology study of the Lake Tana basin
- The Nile Transboundary Environmental Action Project (Regional PMU in Khartoum, Gedion Asfaw, gasfaw@nilebasin.org) is carrying out lake and wetland studies around Lake Tana (www.nileteap.org)
- Eastern Nile Technical Regional Office (Solomon Abate, sabate@nilebasin.org). Eastern Nile Watershed Management Project is studying sites around Lake Tana (Jama, Ribb and Gumera subwatersheds). Also, there is a Cooperative Regional Assessment of land degradation/erosion issues in all Eastern Nile sub-watersheds (country and sub-basin reports, as well as a useful GIS system).

## 11.7 CONSULTANT QUALIFICATIONS AND EXPERTISE REQUIREMENTS

The Consultant must demonstrate that it has the expertise required to fully appreciate the requirements of World Bank Safeguards Policies to be addressed in the ESIA, and relevant Ethiopian requirements, and to complete *all* required sections of the ESIA. The Consultant will be familiar with World Bank environmental and social safeguards policies, and similar requirements in Ethiopia, and have demonstrated experience in successfully meeting these requirements. The Consultant will be particularly familiar with the environmental planning and assessment of projects in the water sector, and with systems for the review and approval of development projects in developing countries like Ethiopia.

The Consultant study team will be composed of experienced professionals, and will include local consultants to ensure study relevance and effectiveness in light of prevailing local conditions. All three key staff (below) should have a minimum of a master's degree or equivalent in their field of specialization or related fields, and at least 10 years of progressively senior experience in related assignments, especially in Africa and preferably in Ethiopia.

Team Leader – an international ESIA practitioner with at least 10 years of progressively senior experience in managing the environmental planning and assessment of large infrastructure projects. A significant portion of this experience will have been for water resource developments. The team leader should meet the guideline standard for a Lead IA Practitioner established by the International Association for Impact Assessment<sup>21</sup>. S/he will have demonstrated expertise in:

- the design and implementation of environmental data collection, analysis, planning and assessment programs to support feasibility studies and the preparation of ESIA's and EMP's required by national governments and international lending agencies;
- working effectively with engineering teams preparing feasibility studies of infrastructure projects to ensure environmental and social factors are adequately considered in the development of project plans and designs; and
- working effectively with public sector clients, and in implementing effective consultation programs with project area peoples.

<sup>21</sup> See guideline at [http://www.iaia.org/Non\\_Members/Pubs\\_Ref\\_Material/CC1%20Guidelines%20Lead%20Professionals.pdf](http://www.iaia.org/Non_Members/Pubs_Ref_Material/CC1%20Guidelines%20Lead%20Professionals.pdf)

Lead Aquatic Ecologist – a senior ecologist with at least 10 years of progressively senior experience in the planning and assessment of large infrastructure or watershed management developments involving important water resource values. S/he will have strong experience in analysis and planning to avoid and/or minimize impacts on aquatic habitats (rivers, lakes, wetlands) and dependent species.

Lead Terrestrial Ecologist – a senior ecologist with at least 10 years of progressively senior experience in the planning and assessment of large infrastructure or watershed management developments involving important terrestrial biodiversity and/or landuse values. S/he will have strong experience in analysis and planning to avoid and/or minimize impacts on terrestrial habitats and dependent species, and to enhance sustainable watershed management and development.

The Consultant team will include complementary and/or supplementary expertise, international or local, to ensure adequate coverage of the following subjects in the ESIA:

- Aquatic and terrestrial ecology
- Rural sociology
- Hydrology
- Environmental health
- Cultural heritage
- Soils, vegetation and drainage
- Agronomy/plant science
- Integrated pest management
- Natural resource economics

Consulting firms will submit with their proposal the organization and staffing structures for implementing these ToR. Consulting firms submitting proposals must confirm the availability of team members with sufficient management and specialist expertise to satisfy these ToR.

## 11.8 SCHEDULE AND DELIVERABLES

It is expected that this ESIA assignment will be completed within seven (7) months. This includes at least fourteen (14) person-months for the three key team members described above.

Deliverables will be:

- An Inception Report will be delivered within six (6) weeks of contract effectiveness for review and approval by the Client. The inception report will include an overall approach and methodology for carrying out each component of the ToR, including desk and field studies, and consultations. It will provide a detailed plan of work (desk and field), outputs, and staff assignments with levels of effort by task and sub-task. The proposed project schedule will be broken down by tasks and sub-tasks and presented in chart form. The Inception Report will also include a detailed assessment of a) what, if any, data/information gaps exist that may jeopardize successful completion of the ESIA; and b) how those gaps can be filled in a timely manner.
- Monthly Progress Reports will generally summarize the work in progress and completed, staff strength, time spent by each staff member on each task, estimated percent of work completed by task, and the plan of work to be accomplished during the next month.  
Any problems that may cause or be causing delays should be listed, including proposed measures to correct the problem. Reports should include a financial summary, indicating amounts invoiced, amounts disbursed, and any other pertinent financial details.
- The Draft Final Report will be provided to the Client, for review by himself, the World Bank and the Ethiopia EPA, at the end of month five (5) for review and comment.
- The Final Report, incorporating comments on the draft, will be provided to the Government of Ethiopia and the World Bank in both hard (15 copies) and electronic copies.

## 11.9 TECHNICAL PROPOSAL CONTENTS

The Consultant's technical proposal will at least:

- Demonstrate that the Consultant understands the overall scope and nature of ENIDP, of the ESIA and EMP preparation work, and of what will be required to respond satisfactorily to each component of the ToR;
- Demonstrate that the Consultant team has relevant and appropriate experience to carry out all components of the ToR. Detailed curriculum vitae for each team member must be included;
- Describe the overall methodology for carrying out each component of the ToR, including interviews; desk and field studies; and data/information collection and analysis methods; and
- Provide an initial plan of work, outputs, and staff assignments with levels of effort by tasks and sub-tasks.

## 11.10 ANNEX 1: RELEVANT SECTIONS FROM THE FEASIBILITY STUDY TOR

### ENVIRONMENTAL ANALYSES

The Consultant will analyze the environmental sensitivities in each project area and, through the consideration of alternate project designs, develop project proposals that avoid or minimize potential adverse environmental impacts. Environmental sensitivities could include:

- wetlands and river/lake fisheries that are vulnerable to irrigation development from water withdrawal/return (quantity and quality), and from loss of habitat (e.g. in a reservoir, downstream of significant withdrawals, or through encroachment by agricultural activities);
- other local areas with important biodiversity values (aquatic, terrestrial, wildlife, avian) not documented in the Abbay Master Plan;
- unstable or steep slopes that should not be developed for irrigation, and should perhaps be stabilized/restored as sustainably managed natural areas (eg. For fuel wood); and
- the prevalence of water-related diseases, and environmental conditions that contribute to them.

In consultation with the relevant government agencies and the inhabitants of each project area, the Consultant will identify the key environmental sensitivities and carry out secondary and, as required, primary data collection to characterize their scope and nature. The depth of study will be sufficient to adequately inform the development of alternate project designs, the selection of the preferred alternative, and the justification of that selection. Project alternatives that substantially convert or degrade nationally or locally important natural habitats should not be considered unless they include equivalent habitat restoration and maintenance within the project area or elsewhere. Design features to avoid adverse environmental impacts, or enhance environmental / natural resource services, are to be clearly noted in the description of preferred project alternatives, with suitable maps. These may include, for example, wetland buffer zones and management plans, or instream flows to protect fisheries habitat and productivity. Acceptability of the final project design will depend not only on its technical and financial feasibility, but also on its environmental suitability.

## 11.11 ANNEX 2: RELEVANT SECTIONS FROM THE ESMF

### ADVERSE ENVIRONMENTAL IMPACTS

The following section outlines the general key impacts potentially associated with irrigation and drainage projects and proposed mitigation measures.

#### Low flow regime

Changes to the low flow regime may have significant negative impacts on downstream users, whether they abstract water (irrigation schemes, drinking supplies) or use the river for transportation or hydropower. Issues to consider are:



Minimum demands from both existing and potential future users need to be clearly identified and assessed in relation to current and future low flows. The quality of low flows is also important.

Return flows are likely to have significant quantities of pollutants. Low flows need to be high enough to ensure sufficient dilution of pollutants discharged from irrigation schemes and other sources such as industry and urban areas. A reduction in the natural river flow together with a discharge of lower quality drainage water can have severe negative impacts on downstream users, including irrigation schemes.

Habitats both within and alongside rivers are particularly rich, often supporting a high diversity of species. Large changes to low flows ( $\pm 20\%$ ) will alter micro-habitats of which wetlands are a special case. It is particularly important to identify any endangered species and determine the impact of any changes on their survival. Such species are often endangered because of their restrictive ecological requirements.

#### **Mitigation measure**

Integrating low flow release strategies into dam operation protocols or management plans is the best mechanism for mitigating the potential negative impacts of changes to low flows.

### **Flood and sediment transport regimes**

Uncontrolled floods can cause tremendous damage and flood control is therefore often an added social and environmental benefit of reservoirs built to supply irrigation water. It is important that new irrigation infrastructure does not adversely affect the natural drainage pattern, thus causing localized flooding.

Radically altered flood regimes may have negative impacts; for example:

Any disruption to flood recession agriculture needs to be studied as it is often highly productive but may have low visibility due to the migratory nature of the farmers practicing it. Flood waters are important for fisheries both in rivers and particularly in estuaries. Floods trigger spawning and migration and carry nutrients to coastal waters.

Controlled floods may result in a reduction of groundwater recharge via flood plains and a loss of seasonal or permanent wetlands.

Finally, changes to the river morphology may result because of changes to the sediment transport regime of flood waters. This may be either a positive or negative impact, as dams typically interrupt the natural sediment transport regime and can cause downstream scour for many hundreds of kilometres; and

Sediment accumulation in the reservoir can reduce the storage capacity and affect the operational life of the reservoir.

#### **Mitigation measure**

As with low flows, the operation of dams offers excellent opportunities to mitigate the potential negative impacts of changes to flood flows. The protection of flood plains may also be a useful measure as they function as groundwater recharge zones and also attenuate peak discharges downstream. These are additional positive functions of wetlands.

### **Operation of dams and dam safety**

The manner in which dams are operated has a significant impact on the river downstream. There is a range of measures that can be undertaken to reduce adverse environmental impacts caused by changing the hydrological regime that need not necessarily reduce the efficacy of the dam in terms of its main functions, namely irrigation, flood protection and hydropower. Multi-purpose reservoirs offer enormous scope for minimizing adverse impacts. In the case of modifying low flows, identifying downstream demands to determine minimum compensatory flows, both for the natural and human environment, is the key requirement and such demands need to be allowed for at the design stage. The ability to mimic natural flooding may require modifications to traditional dam off-take facilities. In particular, passing flood flows early in the season to enable timely recession agriculture may have the added advantage of passing flows carrying high sediment loads.

A number of disease hazards are associated with dams some of which can be minimized, others eliminated by careful operation. Rooted aquatic weeds along the shore (or in shallow reservoirs) can be partially controlled by alternate desiccation and drowning.

### **Dam safety measures and mitigation**

Currently, there are no dam safety guidelines, and there is no systematic safety monitoring of the existing dams in Ethiopia.<sup>(22)</sup> The World Bank OP 4.37 is the applicable guideline to be used, as it outlines the World Bank dam safety procedures and recommendations.

The dams should be designed using World Bank, FERC and Canadian Dam Association - Dams Safety or other similar internationally recognised standards and guidelines. Provisions for long-term safety monitoring and surveillance should be included. Comprehensive site inspection and supervision is required during construction along with the provision of Emergency Preparedness Plans and Operation, Maintenance and Surveillance Manuals. Dam safety measures should be fully detailed including the provisions for inspections and the reporting of results.

### **Fall of water table**

Lowering the water table by the provision of drainage to irrigation schemes with high water tables brings benefits to agriculture. Lowering the groundwater table by only a few metres adversely affects existing users of groundwater whether it is required for drinking water for humans and animals or to sustain plant life (particularly wetlands), especially at dry times of the year. Springs are fed by groundwater and will finally dry up if the level falls. Similarly low flows in rivers will be reduced. Any changing availability of groundwater for drinking water supply needs to be assessed in terms of the economics of viable alternatives. Poor people may be disproportionately disadvantaged. They may also be forced to use sources of water that carry health risks, particularly guinea worm infection and schistosomiasis.

A number of negative consequences of a falling water table are irreversible and difficult to compensate for example salt water intrusion and land subsidence, and therefore groundwater abstraction needs controlling either by licensing, other legal interventions or economic disincentives.

### **Mitigation measure**

Over-exploitation of groundwater, or groundwater mining, will have severe consequences, both environmental and economic, and should be given particular importance in any EIA.

### **Rise of water table**

In the long-term, one of the most frequent problems of irrigation schemes is the rise in the local water-table (waterlogging). Low irrigation efficiencies (as low as 20 to 30% in some areas) are one of the main causes of rise of water table. Poor water distribution systems, poor main system management and archaic in-field irrigation practices are the main reason.<sup>(23)</sup>

### **Mitigation measure**

Good irrigation management, closely matching irrigation demands and supply, can reduce seepage and increase irrigation efficiency, thereby reducing the groundwater recharge. The provision of drainage will alleviate the problem locally but may create problems if the disposal water is of a poor quality. Apart from measures to improve water management, two options to reduce seepage are to line canals in highly permeable areas and to design the irrigation infrastructure to reduce wastage. Waterlogging also implies increased health risks in many parts of the world.

### **Water quality**

The changing hydrological regime associated with irrigation schemes may alter the capacity of the environment to assimilate water soluble pollution. In particular, reductions in low flows result in increased pollutant concentrations already discharged into the water course either from point sources, such as industry, irrigation drains and urban areas, or from non-point sources, such as agrochemicals leaking into groundwater and soil erosion. Reduced flood flows may remove beneficial flushing, and reservoirs may cause further concentration of pollutants. Where low flows increase, for example as a result of hydropower releases, the effect on solute dispersion is likely to be beneficial, particularly if the solutes are not highly soluble and tend to move with sediments (Dougherty, TC and Hall, AW, 1995).

(22) Solomon Bogale Gebre, 2004. Dam Break Inundation Analysis: Case study, Addis Ababa.

(23) Dougherty, TC and Hall, AW, 1995. Environmental impact assessment of irrigation and drainage projects. FAO Irrigation and drainage paper no 53. FAO, Rome.

## Agrochemical pollution

A high nutrient level is essential for productive agriculture. Under the EIDP Megech scheme, irrigable land will allow for production of cotton, maize, sunflower, sorghum, teff, haricot bean, pepper and rice (all in the wet season); and maize, sunflower, haricot bean, onion and rice (in the dry season).

However, the use of both natural and chemical fertilizers may result in an excess of nutrients which can cause problems in water bodies and to health. In Ethiopia, there is an intensive use of chemical fertilizers and insecticides for the exploitation of the available land. Part of the used fertilizers is usually drained into the surface and groundwater systems. The use of these sources for drinking water supply is at risk due to the presence of nitrogen and phosphorus salts. These run off of fertilizers and pesticides leads to eutrophication and upset aquatic biota and ecosystems (Ethiopian EPA, 2006).

A high nutrient level is toxic to some aquatic life and encourage rapid rates of algae growth which tends to decrease the oxygen level of the water and thus lead to the suffocation of fish and other aquatic biota. Clear water enhances the effect as it enables increased photosynthesis to take place: reservoirs and slow-moving water are therefore most at risk. Some algae produce toxins, and if de-oxygenation is severe, eutrophic conditions occur.

### Mitigation measure

Pesticides and chemicals used for agriculture must be assessed and monitored as part of the EIA process, and measures to ensure compliance with the OP 4.09 must be included in the subproject EMP (the pest management plan component).

## Soil salinity

### (a) Impact of soil salinity

The increased use of agro-chemicals, needed to retain productivity under intensification, can introduce toxic elements that occur in fertilizers and pesticides. On irrigated lands salinization is the major cause of land being lost to production and is one of the most prolific adverse environmental impacts associated with irrigation. In Ethiopia, salinity caused by large irrigation schemes poses a serious threat to the land in the Awash Valley. In the 1980s, thousands of hectares of irrigated land in the middle Awash had to be abandoned due to salination and waterlogging after less than five years of irrigation farming.

The accumulation of salts in soils can lead to irreversible damage to soil structure essential for irrigation and crop production. Effects are most extreme in clay soils where the presence of sodium can bring about soil structural collapse. This makes growing conditions very poor, makes soils very difficult to work and prevents reclamation by leaching using standard techniques (Dougherty, TC and Hall, AW, 1995).

### Mitigation measure

Careful management can reduce the rate of salinity build up and minimize the effects on crops. Management strategies include: leaching; altering irrigation methods and schedules; installing sub-surface drainage; changing tillage techniques; adjusting crop patterns; and, incorporating soil ameliorates. All such actions, which may be very costly, would require careful study to determine their local suitability.

### (b) Impact to groundwater

As part of the Component 1 investments, the area around Lake Tana suitable for groundwater exploitation includes, in particular, the northern and eastern shores of Lake Tana. Here, groundwater potential is significant, relatively flat low lying areas are available, and groundwater is accessible for agricultural purposes. One of the main impacts associated with I&D projects is the potential for increases in soil salinity. This can result in an increase in the salinity of the groundwater which is often associated with waterlogging.

### Mitigation measure

An appropriate and well-maintained drainage network will mitigate against such effects. Saline groundwater can be particularly critical in coastal regions.

Under the EIDP, a rapid assessment of accessible groundwater will be undertaken to determine potential irrigation development options.

### **(c) Impacts from drainage**

Areas with a flat topography or with water tables that have a low hydraulic gradient are at risk from salinization as are areas with soils of a low permeability which are difficult to leach. Groundwater drains, either pipe (tile) drains or deep ditches, carry out the dual task of controlling the water table and through leaching, counteracting the build up of salts in the soil profile. Normally water is applied in excess of the crop water requirement and soluble salts are carried away in the drainage water although in some areas leaching can be achieved during the rainy season (Dougherty, TC and Hall, AW, 1995).

#### **Mitigation measure**

Reducing salt inputs is one way of improving drain water quality. The safe disposal of salts is of prime importance, either to the sea (using dedicated channels if river quality is threatened) or to designated areas such as evaporation ponds where the negative impacts can be contained.

### **Erosion and sedimentation**

Upstream erosion may result in the delivery of fertile sediments to delta areas. However, this gain is a measure of the loss of fertility of upstream eroded lands. A major negative impact of erosion and the associated transport of soil particles is the sedimentation of reservoirs and abstraction points downstream, such as irrigation intakes and pumping stations. Desilting intakes and irrigation canals is often the major annual maintenance cost on irrigation schemes. The increased sediment load is likely to change the river morphology which, together with the increased turbidity, will affect the downstream ecology (Dougherty, TC and Hall, AW, 1995).

Soil erosion rates are greatest when vegetative cover is reduced and can be 10 to 100 times higher under agriculture compared with other land uses. However, there are a wide range of management and design techniques available to minimize and control erosion. For erosion to take place, soil particles need to be first dislodged and then transported by either wind or water.

#### **Mitigation measures**

Both actions can be prevented by erosion control techniques which disperse erosive energy and avoid concentrating it. For example, providing good vegetative cover will disperse the energy of rain drops and contour drainage will slow down surface runoff (Dougherty, TC and Hall, AW, 1995).

### **(a) Local erosion**

The method of irrigation profoundly affects the vulnerability of the land to erosion. Because irrigated land is wetter, it is less able to absorb rainfall and runoff will therefore be higher. Soil erosion by water is an old problem in Ethiopia. The prevalence of mountainous and undulating landscapes, coupled with the expansion of arable farming on steep areas due to population pressure have aggravated the soil erosion problem in the country. Soil erosion is a serious problem particularly in the Ethiopian highland areas, threatening the agricultural sector and causing increased sedimentation of reservoirs and lakes.

Field size, stream size (drop size), slope and field layout are all difficult to change and all significantly affect erosion rates. Careful design can avoid the occurrence of erosion problems. Agricultural practices affect soil structure and therefore the soil's erosivity, or the ease with which particles are dislodged. In general land-forming for irrigation, such as land-levelling and the construction of field bunds, tends to reduce erosion.

Archaic in-field water management practices involving poor cut and fill operations through watercourse embankments can result in serious local erosion at the head end of the irrigated field and in sedimentation at the mid or tail-end locations of the field. The micro-topography of a field will thus be disturbed. Unavoidably, this effect creates disproportionate water distribution over the irrigated field. In addition it might create disputes between water users. Improved water management practices related to surface irrigation methods (for example by using gates, siphons, checks) can reduce such hazards (Dougherty, TC and Hall, AW, 1995).

#### **Mitigation measures**

Irrigation infrastructure needs to be designed to ensure that localized erosion, eg gully formation, does not occur. Construction activities generally expose soil to erosion. Following the completion of construction work, vegetation should be established around structures so that bare soil is not exposed to erosive forces.

**(b) Hinterland effect**

The development of irrigation schemes in developing countries is often associated with an increase in intensity of human activity in areas surrounding the scheme. This may be due to people moving into the area as a result of the increased economic activity or may be carried out by farmers and their families who are directly engaged in irrigation activities. In either case typical activities are: more intensive rain fed agriculture; an increase in the number of livestock; and, greater use of forests, particularly for fuel wood. All these activities are liable to increase erosion in the area by decreasing vegetative cover which will have a detrimental effect on the local fertility and ecology as well as contribute to sediment related problems (Dougherty, TC and Hall, AW, 1995).

Clearing higher non-irrigated parts of the catchment can result in a rising downstream water table. In areas where the groundwater is saline the higher recharge may cause higher salinity levels in the rivers and cause pressure levels in the lower irrigated areas to rise thus impeding leaching. This can be prevented by planting deeper rooting crops and trees in the higher lands.

**Mitigation measures**

Mitigating actions can be put in place relatively easily with forethought as to problems that might arise. For example, allowance should be made for livestock, fuel wood or vegetable gardens within the layout of an irrigation scheme. Alternatively, protection of vulnerable areas maybe necessary.

**(c) River morphology**

Reductions in low flows and flood flows may significantly alter the river morphology, reducing the capacity to transport sediment and thereby causing a build up of sediments in slower moving reaches and possibly a shrinking of the main channel. Increasing flows will have the reverse effect. Where the sediment balance changes over a short distance, perhaps due to a reservoir or the flushing of a sediment control structure, major changes to the local river morphology are likely to occur. The release of clear water from reservoirs may result in scour and a general lowering of the bed level immediately downstream of the dam, the reverse of the effect that might be expected with a general reduction in flows. Changes to the river morphology may effect downstream uses, in particular navigation and abstraction for drinking, industry and irrigation. The river ecology may also be adversely affected (Dougherty, TC and Hall, AW, 1995).

**Mitigation**

Changes to the sediment transport regime caused by dams or check dams are very difficult to mitigate. One possible technique is to periodically flush the reservoir by opening a bottom gate (this gate must be installed during construction such that its invert is close too the original invert of the stream channel, e.g., the lowest point of the channel) and allowing the accumulated sediment to wash out. This is best done on a regular basis and with flows sufficient to distribute the sediment fairly evenly downstream. If done irregularly, the released sediment can choke the channel, reducing channel capacity and causing localized flooding.

The most important mitigation measure is to determine a minimum flow ( often termed an "environmental flow" or "ecological flow"), and assure that this minimum flow is maintained, especially during seasonal low flow periods. There are a number of methods for determining the minimum ecological flow, but many of these are simplistic. A recommended approach is the "holistic Instream Flow Need (IFNs)" method developed by Anderson et al. 2006, or the Scenario Based Holistic Approach to Environmental Flow Assessments for Rivers (King, Jackie, et al., 2003).

Flushing the sediment and maintaining a functional minimum flow will in combination mitigate the adverse impacts to the sediment transport, hydrologic and hydraulic regimes of the affected river or stream.

**(d) Channel structures**

The susceptibility of channel structures to damage is strongly related to changes in channel morphology and changes in sediment regime. Increased suspended sediment will cause problems at intake structures in the form of siltation as well as pump and filtration operation. Abstraction structures may become clogged with sediment or left some distance from the water. Degradation of the river bed is likely to threaten the structural integrity of hydraulic structures (intakes, headworks, flood protection etc.) and bridges.

**Mitigation**

The best mitigation measure is to maintain the river's pre-existing hydrologic, hydraulic and sediment transport regimes as described above.

### **(e) Sedimentation**

Irrigation schemes can fail if the sediment load of the water supply is higher than the capacity of the irrigation canals to transport sediment. Sediment excluders/extractors at the headworks can mitigate this effect to some extent. Sedimentation is a disturbing problem for all the reservoirs in the Ethiopian highlands. Some reservoirs are filled with sediment within two to three years i. e. a much less time than from their economic life (20 to 25 years).

Sedimentation from within the scheme itself can also be a problem, for example, wind-blown soil filling canals. Canal desilting is an extremely costly element of irrigation maintenance and design measures should minimize sediment entry. Reservoir siltation shortens the active life of the reservoir and must be given careful consideration at the design stage. The increases in erosion due to the economic activity prompted by the reservoir and its access roads needs to be taken into account. Upstream erosion prevention, particularly within the project catchment is an important consideration of an EIA. However, this may not be sufficient to significantly reduce reservoir sedimentation, especially in view of the time delay between soil conservation activities and a reduction in river sediment loads (Dougherty, TC and Hall, AW, 1995).

#### **Mitigation**

Soil erosion measures on a watershed wide basis are the recommended best management practice. This should include basic agricultural techniques including contour farming, and planting of winter crops. Additional methods include maintaining grassed swales in areas where runoff concentrates, maintaining brush or forest buffers along all stream courses of all types (e.g., channels or swales with ephemeral, intermittent or perennial flow).

Special attention should be given to preventing rill/gully formation as this is a major slope process that produces significant sediment. If rills or gullies are present, then measures to combat or eradicate same should be implemented. The US Department of Agriculture provides extensive guidance in the form of manuals and reports to address rill and gully prevention and remediation.

### **Biological and ecological impacts**

The main impacts associated with I&D projects are a consequence of the change of land use and water use in the project area but effects on the land around the project and on aquatic ecosystems that share the catchment are also likely. The overall habitat as well as individual groups (mammals, birds, fish, reptiles, insects etc.) and species need to be considered. Rare and endangered species are often highly adapted to habitats with very narrow ranges of environmental gradients. Such habitats may not be of obvious economic value to man, eg arid areas, and therefore current knowledge of the biota may be poor and a special study may be required. Under the EIDP, environmentally sensitive areas such as the Megech River and Lake Tana are considered important ecological considerations. The Megech River is used as a spawning site for Lake Tana fish species (*Barbus spp.*, *Oreochromis spp.*, and *Clarius spp.*) Parts of the Lake Tana margin and the Forgera Plain and surrounding wetland systems are important habitats, especially for birds.

The consumption of water for irrigated agriculture and the reduced quality of return flows is likely to adversely impact on downstream ecosystems. Reduced flows, increased salt concentrations, lower oxygen levels, higher water temperatures and increased pollution and silt loads all tend to favour vigorous, tolerant species (aquatic weeds). The demands of different ecotypes will change through the year both in quantity and quality.

#### **Mitigation measures**

The nature of irrigation, ie providing water to water-short land, will radically change both the agricultural and natural ecology in the project area. The creation of compensation areas or habitat enhancement within and/or outside the irrigation command area may be useful mitigation measures where the natural habitat change is assessed as detrimental. The creation of reservoirs and channels provides the possibility of enhanced aquatic habitats. In particular, reservoirs and channels offer the opportunity of pisciculture and aquaculture and favourable habitats for water fowl, both permanent and migrating, but may also offer favourable habitats for disease transmitting insects and snails. Bird sanctuaries and wildlife parks can be created around reservoirs (Dougherty, TC and Hall, AW, 1995).

## POTENTIAL SOCIO-ECONOMIC IMPACTS

The major purpose of irrigated agriculture is to increase agricultural production and consequently improve the economic and social well-being of the area of the project. Although irrigation schemes usually achieve this objective, changing land-use patterns are a common cause of problems.

In Ethiopia, the construction of dams has caused social, environmental, and economic problems by increasing the relocation of communities against their will and inducing watershed land degradation. The failure to recognise people as partners in the planning and implementation processes is a major characteristic of irrigation and drainage development projects.

### **(a) Impacts on land rights**

Modern water development schemes have often become arenas of multiple conflict, of which the following are worth noting: a) there is conflict among water users over water allocation, land rights, or maintenance issues; b) conflict may arise between users and the authority responsible for the project over inappropriate design of infrastructure, peasant relocations, water charges, or management issues; c) conflict between project beneficiaries and non-beneficiaries is often inevitable. The latter often question the justice of being excluded from the benefits of water projects. Indeed, project beneficiaries are frequently considered enjoying special privileges that are denied other households without any justification; and d) finally, there is conflict between donor agencies and the recipient country over design, management, environmental impact, and financial issues.

Small plots, communal land-use rights, and conflicting traditional and legal land rights all create difficulties when land is converted to irrigated agriculture. Land tenure/ownership patterns are almost certain to be disrupted by major rehabilitation work as well as a new irrigation project. Access improvements and changes to the infrastructure are likely to require some field layout changes and a loss of some cultivated land.

User participation at the planning and design stages of both new schemes and the rehabilitation of existing schemes, as well as the provision of extension, marketing and credit services, can minimize negative impacts and maximize positive ones. Consultations with and the assistance of NGOs can also greatly minimize adverse socio-economic impacts.

### **(b) Population change**

Irrigation projects tend to encourage population densities to increase either because they are part of a resettlement project or because the increased prosperity of the area attracts incomers. Major changes should be anticipated and provided for at the project planning stage through, for example, sufficient infrastructure provision. Impacts resulting from changes to the demographic/ethnic composition should also be considered.

### **(c) Income generation:**

The most common socio-economic problems reducing the income generating capacity of irrigation schemes are:

the social organization of irrigation operation and maintenance (O&M): who will carry out the work (both operation and maintenance); when will irrigation take place (rotation schedules); how will fair delivery be determined (communication and measurement). Poor O&M contributes significantly to long-term salinity and water-logging problems and needs to be adequately planned at the design stage.

reduced farming flexibility. Irrigation may only be viable with high-value crops thus reducing activities such as grazing animals, operating woodlots;

insufficient external supports such as markets, agro-chemical inputs, extension and credit facilities;

increased inequity in opportunity, often as a result of changing land-use or water use patterns. For example, owners benefit in a greater proportion than tenants or those with communal rights to land.

changing labour patterns that make labour-intensive irrigation unattractive (Dougherty, TC and Hall, AW, 1995).

Improved planning, with user involvement, has the potential to reduce if not remove the above problems for both new and rehabilitation projects. Extension services, with training and education, also offer much scope to improve the income and amenity of irrigation schemes.

### **(d) Human migration**

Large, new irrigation schemes attract temporary populations both during construction and during peak periods of agricultural labour demands and provision for their accommodation needs to be anticipated. The problems of displacement during project construction or rehabilitation can usually be solved by providing short-term support.

**(e) Human health**

Dams and impoundments can create a variety of health risks, in part because of ecological change (mosquito and snail propagation along shallow shorelines, associated with aquatic weeds) and in part because of demographic changes. Depending on the ecological requirements of local vector species any of a range of interventions may be successfully applied; periodic reservoir fluctuation, steepening of the shorelines, controlling aquatic weeds, and siting settlements away from the reservoir. The Environmental Policy of Ethiopia emphasises the control of environmental health hazards in the design and construction of dams and irrigation systems.

**Minority groups**

Minority groups or tribal minorities, such as the pastoralists, can benefit from the increased economic development of a new irrigation area. However, they are often disadvantaged by irrigation development if they are excluded from the scheme because of uncertain land rights and may be pastoralists rather than farmers.

**Mitigation measures**

Minority groups and pastoralists must have representation with the WUAs. Their participation in the decision making process is critical in ensuring that their needs are met and that they are not disadvantaged by the opportunities provided under the Project. The EIAs carried out for the subprojects must clearly specify the public consultation and disclosure plan, which takes into account the consultative process to be used.

**Physical Cultural Resources**

New irrigation schemes should avoid destroying or downgrading sites of value whether that value is aesthetic, historical, religious, mineral, archaeological or recreational. A change in water table, associated with well-established schemes, can threaten buildings.

**Mitigation measures**

Appropriate measures for prevention and protection of cultural property during civil works will be implemented as part of the EMP. Chance find procedures will be adhered to, as outlined in the sample environmental contract clauses in Annex C.

**11.12 ANNEX 3: OUTLINE OF AN INTEGRATED PEST MANAGEMENT PLAN****PEST MANAGEMENT APPROACH**

- a) Current and anticipated pest problems relevant to the project

*Common pest problems and estimated economic impact*

- b) Current and proposed pest management practices

*Describe current and proposed practices, including non-chemical preventative techniques, biological and chemical control. Is optimum use being made of agro-ecosystem management techniques to reduce pest pressure and of available non-chemical methods to control pests? Do farmers and extension staff get sufficient information about IPM approaches that reduce reliance on chemical control?*

- c) Relevant IPM experience within the project area, country or region

*Describe existing IPM practices, projects/programs, research*

- d) Assessment of proposed or current pest management approach and recommendations for adjustment where necessary

*Where the current or proposed practices are not consistent with the principles of an IPM approach, the discrepancies should be discussed and a strategy should be proposed to bring pest management activities into line with IPM.*



## PESTICIDE MANAGEMENT

- a) Describe present, proposed and/or envisaged pesticide use and assess whether such use is in line with IPM principles.

*Provide purpose of pesticide use, type of products used, frequency of applications, application methods. Is pesticide use part of an IPM approach and is it justified? Justification of pesticide use under the project should (a) explain the IPM approach and the reason why pesticide use is considered, (b) provide an economic assessment demonstrating that the proposed pesticide use would increase farmers' net profits, or, for public health projects, provide evidence that the proposed pesticide use is justified from the best available (preferably WHO-supported) public health evidence.*

- b) Indication of type and quantity of pesticides envisaged to be financed by the project (*in volume and dollar value*) and/or assessment of increase in pesticide use resulting from the project
- c) Circumstances of pesticide use and the capability and competence of end-users to handle products within acceptable risk margins (*e.g. user access to, and use of, protective gear and appropriate application equipment; users' product knowledge and understanding of hazards and risks; appropriateness of on-farm storage facilities for pesticides*).
- d) Assessment of environmental, occupational and public health risks associated with the transport, storage, handling and use of the proposed products under local circumstances, and the disposal of empty containers
- e) Pre-requisites and/or measures required to reduce specific risks associated with envisaged pesticide use under the project (*e.g.: protective gear, training, upgrading of storage facilities, etc.*).
- f) Selection of pesticides authorized for use, taking into consideration: (a) criteria in Section 5 below; (b) the hazards and risks (Section 7 below); and (c) availability of newer and less hazardous products and techniques (e.g. bio-pesticides, traps)

## MONITORING AND SUPERVISION

- a) Description of activities that require local monitoring during implementation
- b) Description of activities that require monitoring during supervision visits (*e.g. regarding effectiveness of measures to mitigate risks; progress in strengthening regulatory framework and institutional capacity; identification of new issues or risks arising during implementation*)
- c) Monitoring and supervision plan, implementation responsibilities, required expertise and budget

## 11.13 ANNEX 4: EMP TEMPLATES

Template for Summarizing Mitigation/Enhancement Measures (MEMs)

Project Stage	Project Activity	Potential Environmental Impacts	Proposed MEM	Institutional Responsibilities	Cost Estimates
Pre-Construction phase					
Construction Phase					
Operation and Maintenance Phase					

Template for Summarizing Monitoring Requirements

Project Stage	Mitigation Measure	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities	Cost
Pre-Construction Phase							
Construction Phase							
Operation and Maintenance Phase							



## 12. Annex 12 - Outline of Further Tasks

### TABLE OF CONTENTS

<b>12.1 OUTLINE TOR FOR REVIEW OF FISH PASSAGE ISSUES .....</b>	<b>12-2</b>
12.1.1 Background	12-2
12.1.2 Scope of Work	12-2
12.1.3 Study Location and Duration	12-3
12.1.4 Personnel and Qualifications	12-3
12.1.5 Indicative Budget	12-4
<b>12.2 PROPOSAL FOR RAPID ARCHAEOLOGICAL IMPACT ASSESSMENT BY ARCCH....</b>	<b>12-6</b>
12.2.1 Introduction	12-7
12.2.1.1 The Proposed Projects	12-7
12.2.2 A Rapid Archaeological Survey and Impact Assessment	12-7
12.2.2.1 Objective	12-7
12.2.2.2 Methodology	12-7
12.2.2.3 Members of the Survey Team	12-7
12.2.2.4 Budget Breakdown	12-8
<b>12.3 OUTLINE TOR FOR DEVELOPMENT OF PMP PHASE 2 .....</b>	<b>12-10</b>
12.3.1 Background	12-10
12.3.2 Scope of Work	12-10
12.3.3 Study Location and Duration	12-11
12.3.4 Personnel and Qualifications	12-11
12.3.5 Indicative Budget	12-11
<b>12.4 FISHERIES MANAGEMENT .....</b>	<b>12-12</b>
<b>12.5 AQUACULTURE TRIAL .....</b>	<b>12-14</b>
12.5.1 Background	12-14
12.5.2 Scope of Work	12-14
12.5.3 Project Location and Duration	12-15
12.5.4 Personnel and Qualifications	12-15
12.5.5 Indicative Budget	12-16
<b>12.6 LAKESHORE RESTORATION PILOT PROJECT .....</b>	<b>12-16</b>
12.6.1 Background	12-16
12.6.2 Scope of Work	12-17
12.6.3 Project Location and Duration	12-17
12.6.4 Implementation and Personnel	12-18
12.6.5 Indicative Budget	12-18

## 12.1 OUTLINE TOR FOR REVIEW OF FISH PASSAGE ISSUES

### 12.1.1 Background

As part of ENIDP, the GoE intends to implement two irrigation and drainage schemes in the floodplains around Lake Tana. Both schemes - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) and the Ribb Irrigation and Drainage Project (RIDP) - aim to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The two project areas are similar geographically and ecologically: the areas proposed for development are nearly flat, seasonally-flooded and crossed by rivers and streams which provide habitat for fish. Some of the fish are resident, some are migratory. Of particular concern are migratory fish of the *Labeobarbus* species flock, a group unique to the Lake Tana sub-basin. Some *Labeobarbus* species ascend the rivers flowing into the lake to spawn, and their juveniles may use riverine and wetland habitats to grow before returning to the lake.

Both projects involve the channelisation of existing natural waterways and the construction of siphons, culverts and culverted crossings ("Irish fords") which may affect fish passage. In addition, the Ribb scheme is dependent on construction of a diversion weir across the Ribb River and a canal intake in the headpond above it.

The design consultant for the schemes has prepared drawings of the various types of structure including the diversion weir, complete with a fish ladder. The proposed designs require checking to determine their likely impact on fish passage, and to identify any specific design changes which could reduce or avoid such impacts.

### 12.1.2 Scope of Work

The objective of the assignment is to review the engineering designs for all structures across watercourses important for fish in the two schemes, and where these are deemed likely to significantly impede fish passage, to prepare design adjustments or alternative designs together with any necessary construction, operation and maintenance guidance necessary.

It should be noted that most of the designs are generic, so that a review of one siphon will apply to all similar siphons.

The assignment also includes review of the canal headworks design on the Ribb River to determine whether this is likely to entrain adult or juvenile *Labeobarbus* and if so, to propose practical exclusion measures.

Key background documents are:

- The Feasibility Studies of the two schemes
- The Detailed Design Report of the Megech scheme (and of the Ribb scheme, when available): these include engineering drawings of the structures to be reviewed.
- The BRLi ESIA reports on the two schemes
- Abebe Getahun *et al.* 2008. Fishery Studies of Ribb River, Lake Tana Basin, Ethiopia: Final Report.
- Burnside & Tonkin & Taylor Int. 2009. *Supplemental Work to Ministry of Water Resources - ESIA for the Ribb Dam, Ethiopia - Final Report*. Report for ENIDP, MoWR.
- Wassie Anteneh. 2005. Spawning Migration and Reproductive Biology of *Labeobarbus* (*Cyprinidae: Teleostei*) of Lake Tana to Dirma and Megech Rivers, Ethiopia. MSc thesis, AAU

The specialists will:

- (i) Familiarise themselves with the documentation;
- (ii) Confirm the latest design proposals and exact location of all structures across or along watercourses important for fish: these are understood to be:
  - fully-submerged pipes (siphons) carrying some watercourses under the respective main canals (see Tables at end of TOR for lists of siphons on Megech and Ribb main canals);
  - possibly, culverts carrying some watercourses under the main canals;

- ventilated fords ("Irish crossings" or "semi-drifts") carrying the main canal service roads across watercourses adjacent to the siphons or culverts;
  - major ventilated fords carrying the main canal service roads across the Dirma and Ribb Rivers (one on each);
  - drainage crossings under some of the service roads;
  - the diversion weir on the Ribb River;
  - the main canal intake (headworks) on the Ribb River;
  - drain outfalls: some of the "drains" will be channelised natural watercourses which may be important for fish.
- (iii) Review the designs in relation to international guidelines on fish passage and structures and in the light of the best available knowledge of the requirements of migratory *Labeobarbus*;
- (iv) For those structures which do not guarantee safe fish passage under foreseeable conditions during project operation, identify alternatives that will or should do so, given existing knowledge of *Labeobarbus* behaviour and requirements.
- (v) In similar fashion, consider the specific issue of possible entrainment of fish at the Ribb canal headworks and, if justified, identify practical exclusion measures.
- (vi) Discuss the alternatives with stakeholders (MoWE, MoARD, BoEPLAU and, as appropriate, the supervision consultant) to reach consensus on the most practical alternatives.
- (vii) For the agreed alternatives, provide design criteria and/or designs, together with guidance on their construction and operation.
- (viii) Identify knowledge gaps and provide guidance on monitoring and applied research to fill the gaps and check the performance of the structures.
- (ix) Report on the assignment, including the review, findings, recommendations and designs, the consultative process followed, and the specialists' itineraries, together with drawings, maps, photos and references as appropriate.

In carrying out these tasks the specialists will have in mind the goal of maintaining ecosystem functioning, which requires both habitat and habitat connectivity. The specialists should also bear in mind the local socio-economic context, which may affect the operational aspects of the fish pass at the diversion weir and possibly the siphons: these may require fencing and security to prevent 100% fish predation at these locations by local residents.

### 12.1.3 Study Location and Duration

It is anticipated that the assignment will take 0.5 months, in Ethiopia.

### 12.1.4 Personnel and Qualifications

One international fish passage specialist is required. S/he will work as a team with a national fisheries specialist.

International:

Minimum Master's degree in fisheries science, zoology, or other directly relevant discipline.

Minimum 10 years experience of fish passage and entrainment issues and fish pass design, implementation and monitoring.

Previous experience in sub-Saharan Africa desirable.

Fluent English essential, Amharic desirable.

National:

Minimum Bachelor's degree in zoology or other directly relevant discipline.

Minimum 5 years professional work experience in fisheries issues in Ethiopian highlands.

Fluent Amharic and good English essential.

Previous experience of fisheries issues and infrastructure projects desirable.

## 12.1.5 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
International Fisheries Specialist	Month	0.5	20,000*	10,000
National Fisheries Specialist	Month	0.5	2,000*	1,000
International travel	Flight	1	2,000	2,000
Local travel	4WD/day	5	100	500
"	2WD/day	8	75	600
Internal flights	Flight	2	200**	400
Meeting costs	Lump sum	1	500	500
Miscellaneous costs	Lump sum	1	1,000	1,000
<b>Total</b>				<b>16,000</b>

Notes:

\* includes per diem

\*\* average costs (resident: \$100; non-resident: \$ 300)

Total costs to be split between MPIDP and RIDP.

**Table: Siphons on Megech Main Canal**

Stream	Canal	km	Description
1	MC	0.468	Single square barrel 1.80x1.80 m
2	MC	0.679	Single rectangular barrels 1.50x1.80 m (WxH)
3	MC	0.981	Single rectangular barrel 1.20x1.50 m (WxH)
4	MC	1.705	Single square barrel 2.00x2.00 m
5	MC	3.302	Double rectangular barrels 3.00x2.50 m (WxH)
6	MC	5.470	Double square barrels 2.00x2.00 m
7	MC	6.038	Double square barrels 2.75x2.75 m
10	MC	7.459	Double square barrels 1.75x1.75 m
13	MC	9.317	Double rectangular barrels 3.50x3.00 m (WxH)
15	MC	10.179	Double square barrels 2.50x2.50 m
16	MC	10.720	Double rectangular barrels 2.00x2.50 m (WxH)
18	MC	12.850	Single rectangular barrel 2.25x2.00 (WxH)
19	MC	14.180	Single rectangular barrel 2.25x2.00 (WxH)
20	MC	15.560	Double rectangular barrels 2.25x2.00 (WxH)
24	MC	19.848	Double square barrels 3.00x3.00 m
26	SC12	2.212	Double square barrels 2.00x2.00 m

Source: MPIDP draft Tender Documents, Section VI Works Requirements (Tahal-CECE, 2010)

**Table: Siphons on Ribb Main Canals**

Canal Name	Chainage / Location from km O	Canal Parameters*						Drain Discharge (m <sup>3</sup> /s)
		Q (m <sup>3</sup> /s)	BW (m)	FSD (m)	FB (m)	CBL (m)	FSL (m)	
<b>On Primary &amp; Main Canals</b>								<b>Q 50</b>
PMC	0.900	12.632	5.70	1.90	0.80	1,799.857	1,801.757	61.66
PMC	2.285	12.632	5.70	1.90	0.80	1,799.483	1,801.383	46.33
LMC	0.262	8.589	5.00	1.63	0.70	1,798.884	1,800.514	31.50
LMC	4.262	8.417	5.00	1.62	0.70	1,797.804	1,799.424	27.80
LMC	4.842	8.417	5.00	1.62	0.70	1,797.647	1,799.267	50.47
LMC	6.300	7.811	4.80	1.58	0.70	1,797.253	1,798.833	5.60
LMC	8.435	7.206	4.40	1.57	0.70	1,796.677	1,798.247	224.33
LMC	10.232	6.988	4.40	1.55	0.70	1,796.192	1,797.742	186.94
LMC	11.326	2.517	2.80	1.10	0.50	1,795.892	1,796.992	1.39
LMC	12.670	2.085	2.70	1.09	0.50	1,795.502	1,796.593	95.99
LMC	15.007	2.010	2.70	1.07	0.50	1,794.824	1,795.892	47.13
LMC	17.790	1.859	2.50	0.95	0.50	1,792.498	1,793.448	10.54
LMC	20.392	1.456	2.20	0.88	0.50	1,791.718	1,792.598	22.40
LMC	24.064	1.076	2.00	0.79	0.50	1,790.616	1,791.402	92.38
LMC	25.385	0.240	0.90	0.50	0.30	1,790.220	1,790.720	28.26
RMC	0.340	4.013	3.30	1.30	0.60	1,798.996	1,800.296	549.00
RMC	0.950	4.004	3.30	1.30	0.60	1,798.819	1,800.119	122.77
RMC	4.000	3.938	3.20	1.30	0.60	1,797.934	1,799.234	105.54
RMC	5.750	3.887	3.20	1.27	0.60	1,797.427	1,798.697	8.68
RMC	7.100	3.869	3.20	1.27	0.60	1,797.035	1,798.305	5.92
RMC	8.872	3.826	3.20	1.27	0.60	1,796.521	1,797.791	13.34
RMC	9.950	3.801	3.20	1.26	0.60	1,796.209	1,797.469	12.82
RMC	10.459	3.302	2.90	1.23	0.60	1,796.061	1,797.291	161.31
RMC	12.150	1.104	1.20	1.00	0.50	1,795.569	1,796.569	5.61
RMC	13.460	1.104	1.20	1.00	0.50	1,795.176	1,796.176	268.75
RMC	16.311	0.491	1.00	0.70	0.50	1,794.321	1,795.021	69.19
RMC	17.516	0.378	0.80	0.63	0.30	1,793.959	1,794.589	51.33
RMC	17.965	0.378	0.80	0.63	0.30	1,793.825	1,794.455	18.47
RMC	19.590	0.258	0.70	0.54	0.30	1,793.337	1,793.877	6.32
RMC	22.665	0.167	0.60	0.46	0.30	1,792.415	1,792.875	31.27
RMC	23.025	0.155	0.6	0.45	0.30	1,792.307	1,792.757	22.54
<b>On Secondary Canals</b>								<b>Q25</b>
LSC7	5.019	4.204	3.30	1.31	0.60	-	-	102.32
LSC7A	0.587	1.388	2.10	0.87	0.50			252.45
LSC7A1	0.731	0.258	0.70	0.52	0.40	-	-	154.29
RSC10	2.241	0.067	0.50	0.30	0.30	-	-	121.66

Source: RIDP Feasibility Study, Table C.2-9 (Tahal-CECE, 2010)



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## 12.2 PROPOSAL FOR RAPID ARCHAEOLOGICAL IMPACT ASSESSMENT BY ARCCH

### **A Rapid Archaeological Impact Assessment and Evaluation on Megech Pump (SERABA) Irrigation/ Drainage Project and Ribb Irrigation Project, Northwest Ethiopia**

**Submitted by**

**The Authority for Research and Conservation of Cultural Heritage,  
ARCCH**

**March 2010**

## 12.2.1 Introduction

Environmental Specialist, BRLI, France, a responsible firm to carrying out Environmental and Social Impact Assessment (ESIA) on Megech Pump Irrigation and Drainage Project as well as Ribb Irrigation Project, has reported to the Authority for Research and Conservation of Cultural Heritage (ARCCH) that during surveying its consultant archaeologist has encountered and recorded archaeological and historical remnants within the project areas. Discussion was held, based on the report among the representatives of the consulting firm, the Authority for Water Development and the ARCCH.

The representatives have reached an agreement that the ARCCH will carry out a rapid archaeological impact assessment and evaluation on the project areas. This proposal is the results of the agreement reached among the representatives.

### 12.2.1.1 The Proposed Projects

The projects encompass the Megech Pump (SERABA) Irrigation and Drainage (MPIDP) and the Ribb Irrigation and Drainage Project (RIDP) together with the Ribb Dam, reservoir and Diversion Weir.

#### *Projects Location*

Megech Project is located close to Lake Tana Shore south of the Gonder-Bahr Dar Road and east of Gonder-Gorgora Road. The Megech Irrigation and Drainage Project comprise four Schemes. The MPIDP is the first to be developed and lies fully in Dembia Woreda of North Gonder Zone.

The Ribb Project, on the other hand, is planned to benefit a number of Kebeles in two woredas of South Gonder Zone, namely Libo Kemekem and Fogera.

## 12.2.2 A Rapid Archaeological Survey and Impact Assessment

### 12.2.2.1 Objective

The aim of this archaeological impact assessment and evaluation is to locate, identify and map archaeological/cultural and historical remains that may be negatively impacted by the proposed project and to propose measures to mitigate the adverse impacts.

### 12.2.2.2 Methodology

Literature Review, Remote Sensing, Pedestrian Survey, collecting oral traditions and Consultations will be utilized to collect data. The gathered data analyzed qualitatively and quantitatively. The oral history will discuss scientifically and crosschecked with written historic sources.

### 12.2.2.3 Members of the Survey Team

Six professional archaeologists (Historic and Prehistoric), paleontologist, anthropologist, historian and a GIS expert will be involved in this rapid Archaeological Impact Assessment on MPIDP AND RIDP. The experts are members of the ARCCH and Addis Ababa University.

**12.2.2.4 Budget Breakdown**

**CAR RENTAL AND FUEL**

<u># Vehicles</u>	<u>Daily Rate</u> <u>ET</u>	<u># Days</u>	<u>Total ETB</u>
2	800	10	16,000

**Fuel (MEGECH)**

800 km \*2 day/6 km per liter                      1600/6 = 267 liter\*10.50 =                      **2803**

(From Addis to project area, and Vice Versa)

= 150 km per day\* 8 days /6 km per liter                      150\*8/6 = 200 liter\*10.50 =                      **2100**

1 Liter =10.50 ETB

**Fuel (RIBB)**

600 km \*2 day/6 km per liter                      1200/6 = 200 liter\*10.50 =                      **2100**

(From Addis to project area, and Vice Versa)

= 200 km per day\* 8 days /6 km per liter                      200\*8/6 = 267 liter\*10.50 =                      **2803**

1 Liter =10.50 ETB

**Total                      25,806 Birr**

**STATIONERIES AND MAPS**

**Total                      3000 Birr**

**PER DIEM FOR FIELD WORK**

<u>Experts</u>	<u>#Field day</u>	<u>Daily Rate ETB</u>	<u>Total ETB</u>
6	10	675	40,500

**Local Assistants/Informants**

<u>#Assistants</u>	<u>Daily Rate ETB</u>	<u>#Days</u>	<u>Total</u>
15	70	8	8,400
<b>Total</b>			<b><u>77,706 birr</u></b>

**CONTINGENCIES**

.....

**10% of the Total**

**BUDGET SUMMARY**

- CAR RENTAL AND FUEL	25,806	
- STATIONERIES AND MAPS	3,000	
- PER DIEM FOR FIELD WORK	48,900	
	<b><u>TOTAL</u></b>	<b><u>77,706</u></b>
- CONTINGENCY (10%)	7,770.6	
<b>GRAND TOTAL:</b>	<b><u>85,476.6 ETB</u></b>	

## 12.3 OUTLINE TOR FOR DEVELOPMENT OF PHASE 2 PMP

### 12.3.1 Background

As part of ENIDP, the GoE intends to implement two irrigation and drainage schemes in the floodplains around Lake Tana. Both schemes - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) and the Ribb Irrigation and Drainage Project (RIDP) aim to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The two project areas are similar and affected by many pests and diseases. Pest and disease problems are expected to increase with agricultural intensification, with increased risks to farmers, consumers and the environment, which is highly sensitive.

ENIDP is funded by the World Bank and therefore subject to the Bank's safeguard policies, specifically OP 4.01 Environmental Assessment and OP 4.09 Pest Management. These require the development of an Integrated Pest Management Plan and its integration into the Environmental Management Plan for each scheme.

A Phase 1 Pest Management Plan (PMP) has been prepared as part of the two project's environmental assessment process. These TOR concern development of a Phase 2 PMP.

### 12.3.2 Scope of Work

The purpose of this assignment is to prepare a Phase 2 Pest Management Plan for the Megech and Ribb projects.

The objectives of the Plan will be to sustainably safeguard farmers and their families, consumers and the receiving environment from pesticide hazards associated with agricultural intensification.

Key background documents are:

Phase 1 Pest Management Plan for Megech and for Ribb, available as an Annex in each of the respective ESIA reports

The Feasibility Studies of the two schemes

Akalu Teshome, Melaku Wale, Fentahun Mengistu & Birru Yitaferu (eds). 2009. Agricultural potentials, constraints and opportunities in the Megech and Ribb rivers irrigation project areas in the Lake Tana Basin of Ethiopia. ARARI, Bahir Dar. 140p

The projects' Environmental and Social Management Framework (ERM 2007)

With specific reference to the Bank's Operational Policies OP 4.01 and OP 4.09 and supporting materials and guidance on the Bank's website, the specialists will:

Familiarise themselves with the documentation

Design a participatory process to develop a Phase 2 PMP (a specific operational plan) for the Megech and Ribb schemes

Implement the process with the full involvement of stakeholders

Document the process

Document the Plan, which must be practical, implementable, costed, and agreed by stakeholders; *inter alia*, it should include a formal list of approved pesticides

In carrying out these tasks the specialists will pay due consideration to existing and probable future pests and diseases including those affecting crop storage and the control of livestock pests (vectors); existing pest management practices; farmer skills and knowledge; institutional and capacity issues and constraints; and the knowledge and attitudes of policy and decision-makers.

It is likely that the specialists will identify requirements for policy changes. These should be noted and prioritized. However, the emphasis of the product (the Phase 2 PMP) should be on steps which can be taken at regional and project level.

### 12.3.3

### 12.3.4 Study Location and Duration

It is anticipated that the assignment will take 1 month, mostly in Amhara National Regional State.

### 12.3.5 Personnel and Qualifications

Two IPM specialists are required, one national, one international.

International:

- Minimum Master's degree in agronomy or other directly relevant discipline.
- Minimum 10 years experience of IPM in tropics / sub-tropics.
- Previous experience of World Bank IPM preparation and implementation desirable.
- Previous experience in Ethiopia or region desirable.
- Fluent English essential, Amharic desirable.

National:

- Minimum Bachelor's degree in agronomy or other directly relevant discipline.
- Minimum 5 years professional work experience in agriculture in Ethiopian highlands.
- Training and / or experience in IPM essential.
- Fluent Amharic and good English essential.

### 12.3.6 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
International IPM Specialist	Month	1	20,000*	20,000
National IPM Specialist	Month	1	2,000*	2,000
International travel	Flight	1	2,000	2,000
Local travel**	4WD/day	30	100	3,000
Meeting costs	Lump sum	1	5,000	5,000
Miscellaneous costs	Lump sum	1		1,000
<b>Total</b>				<b>33,000</b>

Notes:

\* includes per diem

\*\* may include local flights

## 12.4 FISHERIES MANAGEMENT

### 12.4.1 Background

As part of ENIDP, the GoE intends to implement an irrigation and drainage scheme in the Dembia floodplain on the north side of Lake Tana. The scheme - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) - aims to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The area proposed for development is nearly flat, seasonally-flooded and crossed by rivers and streams which provide habitat for fish. Some of the fish are resident, some are migratory, specifically certain species of the endemic *Labeobarbus* species flock. Little is known about rainy-season use of the area's wetlands by fish and their spawning and juvenile stage habitat requirements and behaviour.

The project, in combination with other dam, irrigation and drainage projects in the area, is likely to have negative effects on some fish and fisheries. The fisheries are under pressure in any case from unsustainable fishing practices such as use of small-mesh nets, heavy fishing of pre-spawning assemblies, and 100% netting of watercourses.

Recognising the importance of conservation of the lake's fishery resource, the regional government is undertaking various initiatives to improve fishery management and conserve the resource. These initiatives include two directives which it is understood will be approved very soon and will form the practical legal basis for a significant programme of fisheries management and enforcement at kebele level:

- Directive for Providing Fishing Licence.
- Directive for Assignment of Fish Inspectors.

With support from FAO, the ANRS government's Bureau of Agriculture and Rural Development (BoARD) intends to establish Kebele Fish Management Units in each of the kebeles bordering the lake, and through these to enforce the fisheries regulations and provide extension information to fishers. There is also significant interest in the establishment of a hatchery and (in line with national policy) the promotion of aquaculture.

The MPIDP provides an opportunity for several fish-related measures to mitigate or offset the project's impacts, as noted below.

### 12.4.2 Scope of Potential Fisheries Management Measures

Note: these measures are in addition to the measures designed to maintain and protect fish habitat described in the ESMP (principally maintenance of hydraulic connectivity between rivers and wetlands, maintenance of fish passage along all rivers and tributaries by appropriate design and construction of structures (see Annex 12.1), protection of wetlands, restoration of lakeshore zone (see Annex 12.6), protection of water quality).

#### Wet Season Fish Survey

To date there has been no scientific investigation of the wet season fisheries of the Dembia Plain, except for limited graduate student research on the Labeobarbs in the Megech River. In relation to the project, a survey is required to formally establish the extent of use of the Dirma and its tributaries for spawning by *Labeobarbus* species and the subsequent use of the watercourses and wetlands by *Labeobarbus* juveniles and by tilapia and catfish.

#### Support for Kebele Fish Management Units

Locally, pressure on the remaining fish stocks can be reduced and the resource conserved by changing fishing practices. Following the appointment and training of Woreda Fish Inspectors under the new Directive, these measures will include the establishment and training of Kebele Fish Management Units (with support from FAO), and subsequently the licensing and training of fishermen, establishment of bans on practices such as 100% netting of watercourses and use of small-mesh nets, and a closed period during spawning.

The major fisheries activities should include:

- designation and monitoring of official landing sites, the principal one being at Gorgora (probably near the former fisheries research centre). Responsibility: Dembia WoARD / BoARD.
- licensing of fishermen, including enforcement. Responsibility: Dembia WoARD / BoARD.

- closure of fishery during migration. Responsibility: Dembia WoARD with fishers' cooperatives.
- regulation of net mesh size (gill nets). Responsibility: Dembia Woreda extension staff with fishers' cooperatives.
- provision of credit for fishing gear, boats, cold stores etc. Responsibility: NGOs such as Fish for All, local credit organisations (banks?).

The project could support these initiatives by providing training venues, support for workshops, materials, transport and integration with other project activities such as support for vulnerable groups and the lakeshore zone restoration programme.

### **Support for Regional Hatchery and Associated Research**

Policy makers, fisheries scientists and managers are keen to see an expansion of aquaculture in the Lake Tana area. At present this is in its infancy. Successful aquaculture depends on a reliable supply of fish seed, which requires both a hatchery and skills in techniques appropriate to each species of fish. The principal needs are seen as being (i) a regional hatchery located near Bahir Dar and managed (for reasons of both sustainability and skills) by BFALRC; (ii) research into the specific methods of obtaining fish seed from the various *Labeobarbus* species (this is not a problem for tilapia and catfish).

The project could support these initiatives by, for example, contributing to the establishment costs of the hatchery and or the proposed Lake Tana Trust Fund.

### **Canal Aquaculture Trial**

See Annex 12.5.

### **Fish Entrainment**

During project operation fish will become entrained (sucked into) the pumps. The numbers and impacts of this process should be monitored. This requires a purpose-designed survey which would be ideal as a research topic for graduate students in fisheries, zoology or environmental science.

The project could provide funds to support this monitoring / research activity.

## **12.4.3 Project Location and Timing**

### **Wet Season Fish Survey**

Timing: first wet season when funding is available, ideally 2011.

Location: all wetlands in and adjacent to command area and all natural watercourses passing through it, focusing on the Dirma River and its tributaries. If funds allow, extend the survey to the Megech River and to smaller watercourses passing through the Dembia Plain to the east (Megech Pump (Robit) area).

### **Support for Kebele Fish Management Units**

Timing: start in first year of Construction and continue through all years.

Location: Seraba Dabelo and Achera Mariam Kebeles.

### **Support for Regional Hatchery and Associated Research**

Timing: depends on progress with regional initiatives.

Location: Bahir Dar.

### **Canal Aquaculture Trial**

Timing & Location: see Annex 12.5.

### **Fish Entrainment**

Timing: first and / or second years of project operation.

Location: pumping station.



## 12.4.4 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
Wet Season Fish Survey	Lump sum	1	20,000	20,000
Support for Fisheries Management	Lump sum/yr	8	25,000	200,000
Support for Hatchery & Research	Lump sum	1	50,000	50,000
Aquaculture Trial	See Annex 12.5			
Pump Entrainment Study	Lump sum	1	5,000	5,000
Total				275,000

## 12.5 AQUACULTURE TRIAL

### 12.5.1 Background

As part of ENIDP, the GoE intends to implement an irrigation and drainage scheme in the Dembia floodplain on the north side of Lake Tana. The scheme - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) - aims to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The area proposed for development is nearly flat, seasonally-flooded and crossed by rivers and streams which provide habitat for fish. Some of the fish are resident, some are migratory, specifically certain species of the endemic *Labeobarbus* species flock. The project, in combination with other dam, irrigation and drainage projects in the area, is likely to have negative effects on some fish and fisheries.

Construction and operation of the project will create a significant volume and area of water in the 80 km of main and secondary canals. These will be maintained at full supply level to avoid cracking of the vertisols through which they will pass. The project also involves the construction of 12 night storage reservoirs, which will have fluctuating water levels. Together, this water infrastructure may provide an opportunity for aquaculture as a source of protein, income and, possibly, mosquito-control<sup>24</sup>.

Aquaculture in the Lake Tana sub-basin is in its infancy and the feasibility of canal-based aquaculture in the Lake's floodplains is not known. However, federal policy is supportive (see the new National Aquaculture Development Strategy of Ethiopia (2009)) and this is reflected in regional initiatives.

This study comprises an **enhancement measure**<sup>25</sup> within the MPIDP ESMP. The relatively high cost of the trial in relation to the potential productivity (see Section 5.4.7.1 in ESIA, Vol. 1) must be considered in the light of the possibility of applying the same techniques to all the other planned irrigation projects in the Lake Tana sub-basin.

### 12.5.2 Scope of Work

The purpose of the study is to determine the biological, economic and social feasibility of canal-based extensive or semi-intensive aquaculture in the Megech (Seraba) command area by practical experimentation.

Key background documents are:

- The MPIDP Feasibility Study (Tahal-CECE, Feb. 2010).
- The MPIDP Detailed Design Report, which includes engineering drawings of the water structures.
- The MPIDP ESIA report (BRLi, Dec. 2010).
- The Detailed Implementation Manual for Environmental and Social Management of Ribb River Fish Resources (latest version; a draft interim report became available in Sep. 2010): this report focuses on the Ribb River fishery but is of direct relevance to the overall Lake Tana fishery.

<sup>24</sup> Malaria is a significant problem in the area at present, and the canals may provide additional habitat for the mosquito vectors if vegetated and not flowing fast.

<sup>25</sup> Enhancement measure: a non-essential measure which, for a relatively low cost, may be added to a project to bring significant benefits.

The study will involve:

- (i) Inspection of the MPIDP after construction.
- (ii) Discussion with the off-farm operator to determine suitable locations for experimentation, including a review of the value of including night storage reservoirs in the study.
- (iii) Discussion with local residents to identify and involve potential aquaculturists in the experiments.
- (iv) Identification of a source of fish stock - tilapia and catfish (Note 1: no exotic species are permitted in the Lake Tana sub-basin in order to preserve its ecological integrity; Note 2: there are several proposals hatcheries in the region; the timing of their development is not certain at present).
- (v) Stocking.
- (vi) Management of stock: (a) extensive; (b) semi-intensive.
- (vii) Harvesting.
- (viii) Sales.
- (ix) Economic and technical analysis to determine commercial viability.
- (x) Participatory social analysis to determine organizational viability, including practical details of resource management and licensing.
- (xi) If the results are promising, development of a fully costed plan for further, phased development of this type of aquaculture, including all requirements for training, extension, credit, facilities, equipment and other necessary support for local aquaculture enterprises.

### 12.5.3 Project Location and Duration

The study location is the command area of the MPIDP in Dembia Woreda, North Gonder Zone, ANRS.

The study should not commence before Year 4 of the 8-year scheme to allow for (a) construction, and (b) establishment of a predictable canal operation regime.

The study should last two full hydrological years to allow for (a) an initial year of experimentation, and (b) a second year of trials based on the lessons from the first year.

### 12.5.4 Personnel and Qualifications

Two aquaculture specialists are required, one national and one international. The international specialist will provide aquaculture expertise (biological, technical and social) on an intermittent "mentor" basis, whilst the national specialist will implement the study on the ground.

Both specialists will work closely with counterpart staff from ANRS BoARD and BFALRC. Consideration should also be given to involvement of Bahir Dar University (BDU): the study provides an excellent research and training opportunity for fisheries students.

International:

Minimum Master's degree in aquaculture, fisheries science or other directly relevant discipline.

Minimum 10 years experience of sub-tropical aquaculture, including extensive and semi-intensive systems.

Significant experience of the social aspects of aquaculture, specifically the establishment and support of small-scale aquaculture enterprises.

Previous experience in sub-Saharan Africa desirable.

Fluent English essential, Amharic desirable.

National:

Minimum Bachelor's degree in zoology or other directly relevant discipline.

Formal training in aquaculture essential (e.g. workshops, post-graduate courses).

Minimum 5 years professional work experience in fisheries issues in Ethiopian highlands.

Fluent Amharic and good English essential.

Previous experience of fisheries issues and infrastructure projects desirable.

## 12.5.5 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
International Aquaculture Specialist	Month	3.0*	20,000**	60,000
National Aquaculture Specialist	Month	12***	2,000**	24,000
On-site staff and incentives	Month	24****	500	12,000
International travel	Flight	6	2,000	12,000
Internal flights	Flight	8	300	2,400
Pickup (4WD)	Item	1	27,400*****	27,400
Vehicle O&M	Month	24	250	6,000
Other equipment	Lump sum	1	5,000	5,000
Meeting costs	Lump sum	4	500	2,000
Miscellaneous operating costs	Lump sum	1	5,000	5,000
<b>Total</b>				<b>155,800</b>

\* 6 inputs over two years, each of 0.5 months

\*\* includes per diem

\*\*\* assumes 50% time input over two years

\*\*\*\* covers local staff at site, involvement of BoARD / BFALRC counterparts and BDU students

\*\*\*\*\* duty-free

## 12.6 LAKESHORE RESTORATION PILOT PROJECT

### 12.6.1 Background

As part of ENIDP, the GoE intends to implement an irrigation and drainage scheme in the Dembia floodplain on the north side of Lake Tana. The scheme - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) - aims to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The area proposed for development is nearly flat, seasonally-flooded, crossed by rivers and streams and interspersed with permanent and seasonally flooded wetlands. These provide habitat for fish, birds and other wildlife, including rare, endangered and migratory species. The wetlands include a zone along the lakeshore subject to annual fluctuations of the lake water level and formerly covered by the papyrus swamp vegetation for which Lake Tana is famous. This zone is important for many ecological, economic and cultural services - as a fish nursery, for migratory and resident birds, for hippos and python, for emergency grazing, as a source of roofing material, and as a source of papyrus for cultural ceremonies and the construction of traditional reed boats (*tankwas*).

The area is densely populated and its natural resources intensely utilized. Land holdings are small (~1.07 ha/household). An increasing population and the need for livelihoods has created heavy pressure on the lakeshore zone, especially (a) for seasonal grazing, (b) for seasonal cultivation, especially by younger residents. These pressures, combined with unusual changes in lake level associated with hydropower, have resulted in the lakeshore zone becoming severely degraded by loss of natural vegetation (especially papyrus) and conversion to grassland and farmland.

Operation of the MPIDP requires a fully-functioning lakeshore zone both to act as a natural water-quality improvement mechanism (reducing the loading of agrochemicals in drainage waters before they enter the lake) and to offset habitat losses associated with irrigation development in the command area.

The project provides an opportunity to explore ways to restore the lakeshore zone as a precursor to wider application of the methods around the lake.

In environmental assessment terms, this pilot project comprises a combined mitigation measure and **biodiversity offset**<sup>26</sup>.

<sup>26</sup> Biodiversity offset: definitions vary, but in general, the term "offset" is understood to refer to conservation activity that takes place outside the geographic boundaries of a development site in order to compensate for unavoidable harm, in addition to any mitigation or rehabilitation that may take place on that site (ten Kate *et al.* 2004).

## 12.6.2 Scope of Work

The objective of the pilot project is to sustainably restore the ecosystem and other services provided by the former lakeshore wetland zone immediately south of the command area, specifically between the new pumping station near Gorgora and the old mouth of the Megech River (~10 km).

Key background documents are:

The projects' Environmental and Social Management Framework (ERM 2007).

- The MPIDP *Feasibility Study* (Tahal-CECE, Feb. 2010).
- The MPIDP *Detailed Design Report*, which includes engineering drawings of the proposed drainage channels.
- The MPIDP *ESIA* report (BRLi, Dec. 2010).
- The MPIDP *Resettlement Action Plan* (SMEC, Aug. 2010 (draft)).
- The *Detailed Implementation Manual for Environmental and Social Management of Ribb River Fish Resources* (latest version; a draft interim report became available in Sep. 2010): this report focuses on the Ribb River fishery but is of direct relevance to the overall Lake Tana fishery.
- World Bank Operational Policy 4.04 *Natural Habitats*.

The pilot project will involve:

- (i) Familiarisation with the literature and the environmental and social context, including consultation with the regional BoEPLAU concerning their experience in wetland restoration near Bahir Dar and the BoCTPD concerning their ongoing studies of the lakeshore zone around the whole of Lake Tana.
- (ii) Discussion at Woreda and Kebele level to agree on a start-up location.
- (iii) Clarification of the land certification status and other land use zonation issues and the exact land use boundaries in the area between the command area and the lakeshore.
- (iv) Stakeholder analysis.
- (v) Participatory discussion with stakeholders to agree restoration techniques including (a) physical-biological (e.g. re-planting papyrus, exclusion of grazing, fencing) and (b) social (e.g. co-management, incentives for youth / encroachers to become restorers / guardians).
- (vi) Definition of monitoring indicators, (a) ecological (e.g. extent and condition of vegetation types, fish catches, presence / nesting of key birds) and (b) socio-economic (e.g. establishment of effective, gender sensitive co-management groups, number and type of encroachments, local residents' attitudes, economic returns from cut-and-carry fodder, etc.), followed by surveys to establish baseline conditions of these indicators.
- (vii) Implementation of the chosen approach, which is likely to involve information, education and awareness (IEC) campaigns, establishment of user groups, incentives and/or employment for local residents, demarcation, and physical restoration (replanting), protection (physical - by fencing - and/or social - by education and by local guards / stewards).
- (viii) Monitoring.
- (ix) Evaluation of progress and performance, and adaptation of the pilot project to build on the best approaches and techniques.
- (x) Expansion of the project to the entire lakeshore zone (all three kebeles).
- (xi) Reporting, as a case study.

## 12.6.3 Project Location and Duration

The pilot project location is the three kebeles of Aberja Dhena, Seraba Dabelo and Achera Mariam in Dembia Woreda, North Gonder Zone, ANRS.

The project should commence as soon as possible. Realistically, because the Woreda administration will have a heavy workload implementing the MPIDP's resettlement action plan and organising land redistribution, it will probably be Project Year 3 (start of operation) before it will be possible to start the lakeshore restoration pilot project.

The pilot project will need to continue for at least four years: a first year for planning, surveys, and initial physical activities; a second year for significant progress; and the third and fourth years for upscaling to the full area.

### 12.6.4 Implementation and Personnel

The pilot project will require significant inputs from a variety of technically competent facilitators. Lead skills will include ecology (specifically wetland vegetation restoration) and social science (specifically conflict resolution and the establishment of user groups for management and use of natural resources). Other important skills will include mapping, agriculture and economics.

It is suggested that a 3-person team is established to operate at project level comprising an ecologist and male and female social scientists. As an ecosystem restoration project, it would be logical for the ecologist to act as team leader.

The institutional home of the team could be either the MPIDP Project Management Office or the Operation and Maintenance Contractor. In either case the team should work very closely with concerned government offices and staff at all levels, right down to kebele Development Agents, and with local residents and their representatives.

Ecologist (national):

Minimum Bachelor's degree in botany, environmental science or other directly relevant discipline.

Minimum 5 years professional work experience in wetland conservation issues in Ethiopian highlands, including practical aspects of habitat conservation and restoration.

Fluent Amharic and good English essential.

Social scientists (1 male, 1 female, national):

Minimum Bachelor's degree in sociology, anthropology or other directly relevant discipline.

Minimum 5 years professional work experience in practical implementation of rural development at local level in Ethiopian highlands.

Demonstrated skills in design and implementation and facilitation of participatory processes, conflict resolution processes and multi-stakeholder planning processes.

Experience in establishment and support of natural resource user groups desirable.

Fluent Amharic and fair English essential.

### 12.6.5 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
Professional staff	Month	36*	2,000**	72,000
On-site staff and incentives	Month	48***	500	24,000
Pickup (4WD)	Item	1	27,400****	27,400
Vehicle O&M	Month	48	250	12,000
Boat & engine	Item	1	5,000	5,000
Boat O&M	Month	48	50	2,400
Equipment & materials	Lump sum	4	2,500	10,000
Surveys & monitoring	Year	4	2,500	10,000
Meeting costs	Lump sum	4	500	2,000
Miscellaneous operating costs	Lump sum	4	2,000	8,000
<b>Total</b>				<b>172,800</b>

\* 3 professionals, 3 months/year over 4 years

\*\* includes per diem

\*\*\* covers local staff at site, involvement of BoARD / BFALRC counterparts and BDU students

\*\*\*\*\* duty-free

## 12.7 FORESTRY AND FUELWOOD

### 12.7.1 Background

As part of ENIDP, the GoE intends to implement an irrigation and drainage scheme in the Dembia floodplain on the north side of Lake Tana. The scheme - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) - aims to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The area proposed for development is nearly flat, seasonally-flooded, crossed by rivers and streams and interspersed with permanent and seasonally flooded wetlands. The natural woody vegetation has been cleared both within the command area on the surrounding low hills, except for a few remnant trees and shrubs protected in church compounds. To provide fuelwood, charcoal and building poles local residents have planted eucalyptus, mainly in and around settlements. This is managed by coppicing. Despite the supply of eucalyptus, there is a serious shortage of fuelwood resulting in widespread use of dung (cattle droppings) for fuel, in the form of dried cakes. This has health impacts (indoor smoke), gender-related labour impacts (women are responsible for providing fuel for domestic use), and soil fertility and nutrient management impacts (the manure burnt is not available for return to the soil).

Construction of the project will result in the loss of some 26,416 trees of which 75% are eucalyptus, 21% indigenous, and the remainder (4%) various types of fruit tree. Operation of the project will place increased demands on the soil due to crop intensification. The annual restoration of fertility by flood-borne silt will be stopped by improved flood control. There is no possibility of substituting alternative fuels for cooking or heating in the near or medium term. Consequently it is important to undertake forestry in order (i) to replace trees lost due to construction, (ii) to enhance the fuelwood supply, and (iii) to reduce the use of manure as fuel. Tree planting, care and use will also restore and enhance incomes (fuelwood, poles, fruit, honey, fodder) and provide improved habitat variety, which is important for birds which, in turn, are important for pest control.

In environmental assessment terms, this is a multi-purpose mitigation measure.

### 12.7.2 Scope of Measure

The objective of the measure is to establish 60 ha of locally-managed tree plantations.

Key background documents are:

The projects' Environmental and Social Management Framework (ERM 2007).

- The MPIDP *Feasibility Study* (Tahal-CECE, Feb. 2010).
- The MPIDP *Detailed Design Report*, which includes engineering drawings of the proposed drainage channels.
- The MPIDP *ESIA* report (BRLi, Dec. 2010).
- The MPIDP *Resettlement Action Plan* (SMEC, Aug. 2010 (draft)).

The activities will involve:

- (i) Familiarisation with the literature and the environmental and social context, including consultation with the regional BoEPLAU and BoARD concerning their experience in local tree plantation establishment and management.
- (ii) Discussion at Woreda and Kebele level to agree on start-up locations.
- (iii) Identification of sources of planting stock.
- (iv) Participatory discussion with stakeholders (householders and IWUAs) to agree details of implementation and management, especially protection and use.
- (v) Planting, protection (especially against livestock).
- (vi) Monitoring (area of plantations, numbers and types of trees planted and successfully established, user perceptions of value of trees, use of dung as fuel).

It is suggested that plantations could be (a) around homesteads, and (b) along linear features, specifically road embankments.

Species to be used would depend on local preferences. Eucalyptus would remain the preferred fuelwood, but other species should be considered such as some of the Acacias and *Grevillea robusta*. Fruit trees would include preferred varieties of mango, guava, papaya etc., and multi-purpose trees would include *Cordia africana*, *Acacia albida* and *Milletia ferruginea*, amongst others.

### 12.7.3 Project Location and Duration

The planting activities should take place in all Kebeles affected by the project, but primarily Seraba Dabelo and Achera Mariam.

The project should commence as soon as possible. Realistically, because of the social disruption caused by land acquisition, land redistribution and construction, and the need for IWUA formation, it will probably be Project Year 3 or 4 (start of physical operation) before it will be possible to start planting.

Planting should continue for at least four years, or until a self-sustaining programme is established.

### 12.7.4 Implementation and Personnel

The planting project would be implemented by local residents and managed largely by the new IWUAs. Facilitation and support would be provided by the PSP contractor, in coordination with local Development Agents.

### 12.7.5 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
Planting programme, 15 ha	Year	4	20,000	80,000
Total				80,000

## 12.8 DOMESTIC WATER SUPPLIES

### 12.8.1 Background

As part of ENIDP, the GoE intends to implement an irrigation and drainage scheme in the Dembia floodplain on the north side of Lake Tana. The scheme - the Megech Pump (Seraba) Irrigation and Drainage Project (MPIDP) - aims to convert existing smallholder subsistence agriculture into smallholder commercial agriculture.

The area proposed for development is nearly flat, seasonally-flooded, crossed by rivers and streams and interspersed with permanent and seasonally flooded wetlands. Some 2,000 households live within the command area. Housing consists of single-family wood and mud-walled houses with earth floors and metal or thatch roofs, built within small plots of land generally in low-density settlements on slightly better drained sites.

Domestic water is obtained from improved wells, some with hand-pumps, unimproved wells, watercourses and the lake. Livestock may be watered from the same sources. In general water quality is bacteriologically low, especially during the rainy season. Obtaining water is generally the responsibility of women and girls, and makes considerable demands on women's time.

Uptake of the project's economic opportunities may be delayed if women are unable to contribute their time and effort to agricultural intensification due to continuing high domestic workloads. These workloads are caused, in part, by the need to obtain water for household needs, and by the need to provide health care to household members sickened by unsafe water.

The project provides an opportunity to reduce demands on women's time caused by the search for water, and to improve health standards by improving the quality of domestic water supplies.

In environmental assessment terms, this is a mitigation measure for the increased labour demands caused by agricultural intensification, but with many other socio-economic benefits.

## 12.8.2 Objective and Scope of Measure

The objective of the measure is to provide and maintain one safe water supply point for every 50 households in the command area (total 40).

Typically each water supply point will be a shallow well fitted with a robust, locally-repairable hand pump. The wells will be lined by locally manufactured concrete rings.

To ensure sustainability, the wells will be owned and maintained by a local user group to which benefiting households will pay a fee.

Water quality will be assured by establishing a water quality testing programme and associated well disinfection service, hosted by the Woreda administration in Kola Diba. This will involve upgrading an existing room to become a simple testing laboratory with appropriate analytical equipment and consumables, sampling bottles, and a motorcycle with rack or panniers for transport.

Key background documents are:

The projects' Environmental and Social Management Framework (ERM 2007).

- The MPIDP *Feasibility Study* (Tahal-CECE, Feb. 2010).
- The MPIDP *Detailed Design Report*, which includes engineering drawings of the proposed drainage channels.
- The MPIDP *ESIA* report (BRLi, Dec. 2010).
- The MPIDP *Resettlement Action Plan* (SMEC, Aug. 2010 (draft)).

## 12.8.3 Project Location and Duration

The measure will be implemented within the project command area, focusing on households within Seraba Dabelo and Achera Mariam Kebeles.

Construction should be carried out over a two-year period at maximum, but only one the concerned households have agreed to the proposed ownership, maintenance and fee mechanism.

Water quality testing and well disinfection should be carried out every year, continuously.

## 12.8.4 Implementation and Personnel

The measure can be implemented by the Woreda subject to the provision of additional resources for staff, training and logistics (transport), or through the PSP contractor, or by an NGO on contract (e.g. ORDA).

Staff should include at least one female social scientist to ensure appropriate gender-sensitive interaction with residents and the establishment of appropriate gender-sensitive user groups.

## 12.8.5 Indicative Budget

Item	Unit	Quantity	Cost per Unit (USD)	Total Cost (USD)
Shallow well with hand pump	Item	40	4,500	180,000
User group formation and support	Item	40	500	20,000
Water quality lab + motorcycle	Item	1	25,000	25,000
Total				225,000