Ethiopia

Gibe III Hydropower Project

Independent review and studies regarding the Environmental & Social Impact Assessments for the Gibe III Hydropower Project

Final report

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Prepared by

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Glossary

ACP	African, Caribbean and Pacific countries
AfDB	African Development Bank
ARWG	Africa Resources Working Group
BAT	Best Available Technology
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
EA	Environmental Assessment
EAP	Environment Action Programme
EC	European Commission
EEA	European Environment Agency
EEPCo	Ethiopian Electric Power Corporation
EFTA	Economic Financial and Technical Assessment
EIA / ESIA	Environmental Impact Assessment / Environmental & Social Impact Assessment
ESIA-DS	ESIA Downstream Studies
EIB	European Investment Bank
EIF	European Investment Fund
EIS	Environmental Impact Study/Statement
EMAS	Eco-Management and Audit Scheme
EMU	Environmental Management Unit
ESMP	Environmental and Social Management Plan
EPE	European Principles for the Environment
ESIR	Environmental and Social Independent Review
EU	European Union
FIDIC	International Federation of Consulting Engineers
GHG	Greenhouse Gas
Hm3	Cubic hectometre (1,000,000 m3)
ICOLD	International Commission on Large Dams
IFC	International Finance Corporation
ILO	International Labour Organisation
IPPC	Integrated Pollution Prevention and Control
IUCN	International Union for the Conservation of Nature
MFI	Micro-Finance Institution
MFIs	Multilateral Financial Institutions
MDGs	Millennium Development Goals
MOL	Maximum Operational Level
mOL	Minimum Operational Level
MoU	Memorandum of Understandings
NGOs	Non-Governmental Organisations
PAPs	Project Affected Persons
PDP	Public Disclosure Policy
RIU	Resettlement Implementation Unit
SEA	Strategic Environmental Assessment
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WBG	World Bank Group
WCD	World Commission on Dams

Executive summary

At the request of the government of Ethiopia, the European Investment Bank (EIB) is considering a possible support to the Gibe III Project. Prior to any decision, the EIB has appointed Sogreah Consultants (i) to conduct an independent review of the existing environmental and social impact assessment documentation, (ii) to address issues not or insufficiently covered in the studies, (iii) to provide a second opinion where required and (iv) to supplement, where feasible, any additional input deemed necessary.

To perform this study a team of 6 international experts was set up and carried out a review of the ESIA process. Field reconnaissance included an aerial reconnaissance of the Omo River in December 2009 and an 11-day field visit, with emphasis on the Omo downstream plain and the delta area, in January-February 2010.

Overall conclusion

In the upstream zone (construction sites, reservoir area and, Chida-Sodo road area) the Gibe III Project will result in limited impacts on the natural and social environment. Impacts are mainly related to land acquisition and resettlement made necessary by the realignment of the Chida-Sodo road. Consultation with Project Affected People (PAP) has been well performed and resettlement is under preparation.

The downstream impact zone, (Omo River, Omo delta and Lake Turkana) will be more severely affected by the Project. The regulation of the seasonal river flow will modify the river hydrology, which will severely affect the flood recession agriculture carried out along the river banks and on the flood plain by the local population. The suppression of the seasonal submersion of the floodplain will also affect its ecosystems, particularly the grazing lands fundamental for livestock and the spawning areas essential for fisheries. Overall, around 84,200 people could be affected. To mitigate these impacts, the ESIA proposes to create artificial floods.

The Environmental & Social Independent Review Consultant (ESIR) expresses a major concern regarding the absence of detailed baseline information related i) to the hydrological and hydraulic behaviour of the Lower Omo system particularly in the delta region and ii) to the socio-economic system developed in the delta particularly in relation to water management. This lack of information puts into question the logic of the artificial flood regarding i) its technical efficiency particularly in the delta area, ii) its capacity to actively support regional social and economic development, and iii) its sustainability in terms of potential conflict of interest (cost of the floods).

The ESIR Consultant has estimated the cost of the controlled flood to be in the range of 7 to 11 million US$ per year, a cost which may even be higher should the flood need to be increased over the ESIA hypothesis. Additional investigations are deemed necessary in order i) to confirm the technical feasibility of the proposed controlled flood measure, ii) to compare it with alternative mitigation options and iii) to establish a consensual mitigation and development program for the Lower Omo system including the river, its delta and Lake Turkana.

Concerning Lake Turkana water balance, calculations made by the ESIR Consultant show that the first filling of the Gibe III reservoir will have a limited incremental impact on the lake natural water level fluctuations. It is expected that there will be a lowering of the water level by about 1.8 m. This value is close to the annual fluctuations of water level in the lake which is around 1.5 m, and well within the inter-annual fluctuations observed in the past. .

The ESIR Consultant considers the Gibe III project as a major opportunity to initiate the economic development of the Lower Omo, one of the least developed regions of Ethiopia. It is recommended that any financial support to Gibe III development is closely linked to the simultaneous socio-economic development of the Lower Omo region, in order to maximize the benefits from the river flow regulation.

Project description

The project is implemented within the framework of an EPC Contract signed in July 16, 2006, between the Ethiopian Electric Power Corporation EEPCo and Salini Costruttori S.p.A. The 240 m high dam is a classic gravity RCC structure, with a central block which supports the central overflow spillway. The power waterways comprise two tunnel systems, each with an intake structure, a headrace tunnel, a surge tank and a vertical underground pressure shaft.

The powerhouse is located on the left bank of the Omo River, about 500 m downstream from the dam axis. The powerhouse is a 250 m long reinforced concrete structure, housing the 10 generating units and associated equipment. Turbines comprise 10 Francis turbines rated with a net head of 190 m and a flow rate of 102 m^3/s at rated head. The power produced by the Project will be delivered to the Interconnected System through a 65-km-long four double circuit 400 kV overhead transmission line that connects the Gibe III power plant to a new substation at Sodo. A right-of-way, 50 m width, will have to be kept clear from both tree vegetation and structures.

The reservoir area created by the dammed river will be 209 km² at maximum operating level, 145 km² at normal minimum operating level (854 m) and 66 km² at exceptional minimum operating level (800 m). The reservoir will be about 150 km long at maximum level. Its total storage capacity will be 14,700 Million cubic meters (Mm3) at maximum level, including 2,950 Mm3 of dead volume and 11,755 Mm3 of active volume. The Gibe III dam controls about 50% of the Omo catchment area, about 70% of the total water runoff.

New roads will replace the existing Bele-Lala road, that will be partially flooded by the reservoir, with 54 km on the left bank, starting from Bele, and 21 km on the right bank, starting near Lala. The two sections of the road will be connected by a new bridge already constructed across the Omo River, located 1,100 m downstream of the dam.

The construction started in 2006, and by the end of 2009, more than 30% of the construction was completed, but the concreting of the main dam structure is not yet started.

Project Area

The Omo River watershed consists of two contrasting physical features, the mountain area, where the Gibe III complex is located and where the highest rainfalls are observed and a large and arid plain area downstream, where the river meanders along about 550 km before reaching its floodplain (the delta) and eventually Lake Turkana.

In the reservoir area, the vegetation consists of clear deciduous woodland, with a narrow but dense riverine forest along the Omo River banks. In the plain area, the vegetation is of a semi-arid woodland or shrubland, becoming drier when going further south towards the delta. Most of the Omo River in the plain is bordered by a dense riverine forest with 15 to 20 m tall trees. Annual rainfall ranges from up to 1800 mm in the upper catchment, down to 1500 mm at dam site, 300 mm at Omorate and 220 mm at Lake Turkana.

Wildlife is mainly reported from few protected areas located along the Omo River in the plain, therefore far from the reservoir area: Omo and Mago National Parks, the Tama Wildlife Reserve and the Murule Control Hunting Area. Elephant is still reported from the National Parks, but with declining populations because of poaching pressure. The delta area with temporary wetlands and Lake Turkana are rich in birds and crocodiles.

There are 2,057,069 people living in the 11 woredas (~districts) surrounding the future Gibe III Reservoir. However, none of these will have their houses inundated as the reservoir area is rather remote. The inundated area accounts for 7.5% of the land area of the 66 affected kebeles in these 11 woredas.

The population of the 18 kebeles (~sub-districts) crossed by the Chida-Sodo Road realignment and the EEPCo Camp is 85,210. They belong to the two ethnic groups of Wolayta and Dawro.

In the downstream area, the four woredas where potential impacts have been identified have a population of 173,542 according to data obtained by the ESIR Consultant at the woreda offices. The ethnic groups affected are Dasenech, Nyangatom, Murile, Muguji, Karo, Mursi and Bodi.

Vegetation & wildlife issues in the reservoir area

The future reservoir is not overlapping or contiguous to any biodiversity protected area. According to ESIA, vegetation in the reservoir area does not present species of particular interest. The densest vegetation cover is represented by the riverine forest, which is extremely narrow and represents only 18.4 km² out of the 209 km² flooding zone while the open deciduous woodland represents 171.6 km². Wildlife is reported by the ESIA but mainly from secondary data. Additional investigations are deemed necessary to make a better evaluation of the animal biodiversity in the riverine forest system.

It is anticipated in the ESIA that the reservoir will be cleared. Benefits from this clearing have still to be identified. The ESIR Consultant has tentatively simulated the benefit of clearing the riverine forest in terms of reduced GHG emissions, and the impact is not highly significant. The main benefits may come from (i) the collection of the timber and (ii) the induced displacement of the wildlife prior to the first impoundment. However, these are real benefits only if surrounding communities or small enterprises express interest for timber collection (made more difficult because the absence of access roads) and if there is significant wildlife in the forest. Due to the depth of the reservoir, the clearing of the riverine forest will have limited or no effect on the fishery activities.

As forest clearing is expensive and has some negative impacts (particularly the floating debris at the time of the first impoundment, which may create clogging of system inlets), the ESIR Consultant recommends to reconsider the decision for forest clearance until more information on wildlife resources, wood resources and the interest of the local communities or companies for wood collection is obtained. If no interest is expressed, the riverine forest may be simply burnt to reduce its soft biomass and promote the displacement of the wildlife before the flooding process which will be fast (water rise by about 1 to 2 m/day).

The ESIA proposes to develop a buffer zone around the reservoir. The purpose of this protected area is not clear to the ESIR Consultant, which recognizes the development potential represented by the drawdown area which will represent about 70 km² of flooded land annually exposed. The upper part of the drawdown area will be exposed more than 3 months per year, offering, depending on the soil suitability, a potential for agriculture (recession agriculture). Similarly, a large portion of the drawdown area will support grass development, providing pastureland. It is recommended to investigate further (i) the economic development potential of this area and (ii) the justifications and expected benefits of a buffer zone.

Resettlement and livelihood improvement

The Gibe III Project induced resettlement is relatively small for a project of this size. The reservoir flooding will not create any resettlement, but will mainly affect surrounding households through the loss of grazing land. The Chida-Sodo Road realignment and the Employers Permanent Camp will affect 135 households which will lose their houses. Whereas the number of project affected households initially was as low as 355 with only 45 losing their houses, villagers in kebeles near the initial road realignment pledged the project to realign the road so they could benefit from the development that a road close to the villages would lead to. This request was followed and EEPCO has agreed to finance compensation cost for the increased number of households. In addition, 170 households along the proposed Transmission Line will lose their house and small amounts of farm land. These PAPs will be able to relocate their house to another part of their residential land.

Resettlement will typically involve assistance to relocate to a new location. However, vacant land in the scale required is not available in the vicinity of the impact area. PAPs have agreed with the Project to receive cash compensation and they will build new houses on their homestead or find alternative location.

Whereas compensation for houses along the road and camp will be paid according to replacement cost, market value will be used as guideline for houses affected along the Transmission Line. This is not in accordance with neither international nor national standards.

Restoration and improvement of livelihood will follow farm based and non-farm based strategies, depending on how much land is affected for individual households. The farm-based strategies will focus on intensification of agriculture and livestock practices. Households with little remaining land will be offered support to develop small-scale trade, small businesses and services, artisan and handicraft. The RAP also presents options to take part in the future fishery of the Gibe III reservoir, although a management plan is yet to be developed. Limited amount of project-related employment is envisaged. Whether the severely affected households will be capable to embark on these new non-farm based livelihood activities, is yet to be known. Special support will be needed to ensure that all households find activities suitable to their needs and capacities and that both male and female member of the household will benefit.

Targets for support to livelihood improvement have yet to be established as the project cannot limit itself to allocation of a limited support to livelihoods activities. To avoid unnecessary criticism, the project needs to be able to monitor when livelihoods have at least reached the pre-impact levels – and ideally beyond, as indicated in the RAP.

Fisheries

River fisheries are not developed in the future reservoir area, because of distance and access between villages and the river, and because fish is not an important part of the diet in the area.

The future Gibe III reservoir will offer opportunities for fisheries development. Production forecast indicates a potential yield of almost 500 tons per year, which may support full time activity for 150 to 180 fishermen. A Reservoir Fisheries Development Plan should be prepared rapidly, in order to carry out required works for reservoir access before first flooding.

In the downstream plain, fisheries are also presently very limited, except for a few oxbow lakes along the meanders of the Omo River where local communities catch fish. Most of the fishing activities are observed on the shores of Lake Turkana where a landing ground is regularly visited by a private company which collects the production and transports it by refrigerated truck to Arba Minch. The low flow in the Omo River during the dry season is a major limitation to the presence of big fishes which move back rapidly to Lake Turkana after the flood period. The increase of the dry season flow to 500 m^3/s and more will improve the situation and eventually favour the development of fishing activities year long along the river. The reduction of water turbidity will also improve the production of the river, favour plankton and algae development and increase food availability for the fry.

Public health

According to the ESIA, malaria and bilharzia are reported from the future reservoir area, as well as tsetse fly. This is one of the reasons the reservoir area is devoid of any permanent population, the communities being installed at a higher elevation on the plateau, free from tsetse. The ESIA raises a risk of development of these disease vectors because of the reservoir. The ESIR Consultant does not share this point of view, as the reservoir environment and operation will not favour preferred habitat conditions for disease vectors. The risk is probably more serious in the downstream plain with the probable expansion of irrigation, as the mollusc vectors for bilharzia find appropriate habitat for development along the main irrigation channels.

A detailed baseline study around the reservoir area and in the irrigated areas of the downstream plain is recommended before first impoundment, as well as a monitoring of these aspects during at least five years after the reservoir impoundment.

Construction activities

An audit of the construction sites was performed by the ESIR Consultant. The EPC Contractor as well as the Gibe III construction sites were certified OHSAS 18001 (Health and Safety) and ISO 14001 (Environmental Management System) in 2009. The HSE Staff includes 35 staff (3 expatriates) to follow construction activities. The HSE Management Plan and procedures are in compliance with the ISO 14001 principles. Environmental management is effectively and efficiently implemented on site, with collection and treatment of effluents, waste segregation and disposal in a central landfill, recycling of scrap metal, tires and used oils. Hazardous material and waste are correctly managed, registered and handled following safety instructions.

Potable water is produced from 3 treatment units and sanitation relies on septic tanks. The Employers Permanent Camp to be constructed soon will be equipped with a wastewater treatment plant. Effluents are treated before discharge on land. No effluent is directly discharged in a river stream or in the Omo River. The ESIR Consultant considers the HSE management of the construction sites is compliant with the international good practice, by a qualified staff and should not present potential environmental risks in the future.

Greenhouse Gas emissions from the future reservoir

An assessment of the potential Greenhouse Gas (GHG) emissions from the reservoir was carried out by the ESIR Consultant. In average, the estimated GHG emission without pre-impoundment clearing will be 112,000 tons/year over a 30 years period, ranging from 164,000 tons/year the first 10 years to 91,000 tons/year for the last 10 years of the period. This compares well with thermal alternatives of similar production capacity which would release per year 3.23 million tons (Mt, natural gas), 4.83 Mt (fuel oil) and 7.07 Mt (coal). The benefit of clearing the riverine forest would be limited, reducing the cumulated GHG production over 30 years by only 561,000 t (3.372 against 2.810), or only about 17%.

In addition, a preliminary assessment made by the ESIR Consultant shows that the CDM eligibility of the Project would be difficult to obtain because (i) of the size of the project and (ii) of its compliance with the additionality criteria.

Downstream hydrology and controlled floods

The main direct effect of the project will be the alteration of Omo River natural hydrology. In the lower Omo, the present flow ranges from 165 m^3/s in the driest month (February) to almost 1700 m^3/s in the wettest (August). With Gibe III in operation, the dry season flow will increase to 500 m^3/s while the peak flow (in September) will be limited to below 1200 m^3/s.

At present, most of the agricultural production in the plain relies on flood recession agriculture: direct plantation of sorghum and maize on the river banks or in the flooded depressions of the delta as soon as the flood recedes, growth relying on the water retention capacity of the soil. The regulation of the flow will prevent this agricultural practice, yet vital for the local population.

The mitigation proposed in the ESIA-Downstream Study (ESIA-DS) relies on simulated floods created by releasing water from the dam for a period of 10 days early September of each year. Such floods should reach 1600 m3/s in the lower Omo, a flow rate estimated by the ESIA-DS as sufficient to flood river banks and the floodplain. The flood duration is considered sufficient to moisten the soil and flood the depressions.

The ESIR Consultant has several reservations regarding the proposed mitigation: (i) the technical baseline for the estimation of the flood level is extremely limited and further hydrological and hydraulic investigations are necessary to ensure that the proposed flow rate achieves the objectives: to ensure that the water level and duration (10 days) will generate an overflowing water volume large enough to inundate the flood plain an thus preserve wetlands and grazing lands; (ii) the sustainability of the measure, with a risk of potential conflict in the future when energy demand increases, or during draught condition as the release of water may be reduced or not performed; (iii) the fact that the controlled flood just preserves the poverty conditions which prevail at present without any active contribution to regional economic development.

A simulation performed by the ESIR Consultant shows that the flood takes at least 4 to 5 days to reach the downstream area. The 10 days discharge anticipated in the ESIA is probably the shortest duration to consider, a longer period being possibly required to achieve the flooding of the delta. The ESIR Consultant estimated tentatively the cost of the controlled flood. An optimization of the reservoir operation in average year leads to a loss of production of 180 GWh per year or a cost of about 8 to 11 million US$ per year.

Alternative mitigation options to controlled flood, as downstream water management through dedicated structures in the Lower Omo (flap gates dam, weir, intakes, channels) should be considered during such investigations, as these solutions may offer several advantages: (i) Totally independent from energy production, (ii) flexible in duration or frequency of utilization, (iii) can satisfy the inundation of the floodplain and, (iv) can support the promotion of extensive irrigation development programs.

Effects on Downstream Ecology

It is not anticipated that there will be any significant detrimental impact of the project on the Omo and Mago National Parks or on the alluvial forest. However, the suppression of the seasonal flooding of the delta may result in major impacts on wetland biodiversity should an efficient artificial flooding process not be implemented. Additional investigations regarding wetland biodiversity are recommended as the scientific knowledge of the delta area is almost inexistent at present. This should provide a basis for the assessment of the future flooding needs (duration, volume and area).

Effects on Lake Turkana water balance

The assertions of NGOs in their campaign documents stress the dramatic water level decrease of Lake Turkana by 7 to 12 meters during the first impoundment and later, a drastic reduction of inflow because of Gibe III reservoir losses. These statements are not supported by any scientific or technical evidence. The ESIR Consultant estimates the reduction of lake level caused by the first impoundment of Gibe III at about 1.7 m, a value close to the annual level fluctuation of the lake (1.5 m).

During the operation stage, losses should be very limited when compared to the situation before Gibe III: the losses by infiltration are marginal in operation phase and losses by evaporation are only 110 mm/year (difference between the water surface evaporation and the initial evapotranspiration of the vegetation in the reservoir area before impoundment). If no artificial flooding of the plain is performed, Lake Turkana could in the future receive more water than presently for an equivalent hydrological year. With floodplain artificial inundation, the water inflow to Lake Turkana will be equivalent or possibly higher than presently, as the artificial flooding may possibly be more limited than the natural flooding.

Compared to the present situation, water losses for Lake Turkana during Gibe III operation will be limited to 20 Mm3/year from reservoir evaporation and 80 Mm3/year from the irrigation of about 10,000 ha proposed in the ESIA-DS. This total of 100 Mm3/year abstracted from the natural inflow to Lake Turkana (23,000 Mm3/year) represents only 0.4% of the Lake's annual inflow. On a longer term, the development of large irrigation schemes in the plain may affect more significantly the water balance. About 100,000 ha of soils suitable for irrigation were identified during the 1996 Omo Basin Development Plan. Should this area be developed, the annual water demand may represent 1 to 1.5 billions cu. m, or 4.3 to 6.5 % of the annual inflow to Lake Turkana.

Agriculture & livestock

In the Lower Omo plain, the construction of the Gibe III dam will have significant and direct impacts on the reduction of cultivated land on the river banks and flooded areas (flood recession agriculture). The Project would also impact flooding of pasture lands used by pastoralists or agro-pastoralists people in this area who consider raising livestock as the primary livelihood activity.

Approximately 67,600 people depend to some extent on flood recession agriculture. More details concerning cultivated areas and productions are required at kebele level in order to assess and locate the project impacts on the future food availability. There will be no adverse effect on rainfed cropping areas, but the risk of erosion and soil losses will increase through intensified use in these areas in case the main mitigation measure (controlled floods) does not achieve the expected results. No adverse impact is anticipated for irrigated agriculture. In fact, this may be the main beneficiary from the reduced flooding.

At present, pumping stations near the river are frequently damaged by floods, and consequently private farmers and governmental institutions are not investing in permanent irrigation infrastructure. As a result, most irrigation is limited to low capacity portable pumps.

The main periodic hazard that affects the agriculture productions zone is drought which results in crop failure. Interventions in rainfed agriculture will not significantly increase productivity.

As observed in the ESIA-DS, the main mitigation measures (except for the controlled flooding) will concern irrigated agriculture and more particularly the development of small scale irrigation schemes, commercial or not. Availability of irrigation water along the land suitable for irrigation would enable efficient use of these resources and increase agriculture production, provided that the necessary accompanying measures are effectively implemented and maintained over time. Those measures mainly concern the capacity building of the agricultural extension services and the provision of technical assistance, vehicles and equipment to the agricultural extension services in selected kebeles. Considerable opportunities exist for the development of irrigated farming. If properly implemented the ESIA-DS planned programme for irrigated agriculture (small scale irrigation schemes and small scale commercial farms) could be expanded and could benefit a greater number of farmers making self-sufficiency possible. The identification of potentially irrigable areas has to be achieved on the basis of the existing land suitability classification and will require more information on soil salinity and alkalinity in order to avoid posterior issues and ensure the best location.

Of the almost 100,000 ha of pasture lands in the four woredas concerned, a significant part is situated in the delta of the Omo River and depends on the natural fluctuations of the Omo River, Lake Turkana and oxbow lakes. An estimated 16,500 people benefit from natural flooding of pasture land from Omo River. Without mitigation measure, the dam would reduce the natural fluctuation of the lake and river, which would reduce the amount of rangelands available. This may adversely affect the pastoralists using these spaces for their cattle, especially the Dasenech. However, there is no certainty that the artificial flood in its current scale will restore the pasture lands. Other measures could be introduced to support livestock raising. Emphasis should be on increasing livestock production, wealth and income through increased animal efficiency rather than increases in animal numbers – to avoid pressure on fragile grazing lands.

Livelihood development in the Downstream Area

A livelihood development plan for the Downstream Area should be elaborated based on (i) socio-economic baseline data, (ii) detailed information on anticipated impacts including number of people / households in each impact area, and (iii) a land capability assessment and a feasibility study of each livelihood activity recommended. It is crucial for proper implementation of such a plan that the PAPs are consulted on the project in general as well as on their preferred livelihood options.

Special attention to ethnic diversity should be given including cultural heritage, vulnerability, language, gender roles and institutional arrangements for project implementation.

Consultation and disclosure of information

A proper consultation procedure should include : (i) a first early round to cover presentation of the project and anticipated impacts and policy towards mitigation and compensation combined with stakeholders' concerns and suggestions, and (ii) a second round to present in a condensed version provided to the stakeholders, the ESIA conclusions which incorporate feedback from stakeholders. The consultation process for Gibe III Project has so far not been conducted as such.

Consultations in all project areas have included only sampled communities. This is in contrast to the national and international policies that stipulate that all project affected people will be given the chance to take part in consultations. It is not documented that women have taken place in community consultations despite their vital role in livelihood activities.

Summaries of selected ESIA documents are currently being translated to local languages, which is commendable.

In future consultations, it must be ensured that:

- All potentially affected communities are included.
- Both men and women take part, if necessary in separate groups.
- Presentations are made in a way that is easy to understand, reflecting local language and literacy level and using simple illustrations
- Feedback from concerns and suggestions raised at previous consultations is provided.

Existing ESIA documents have been made publicly accessible on the Gibe III Project website, although the latest version of the Resettlement Action Plan (RAP) from December 2009 has not yet been posted. Project summaries in respective languages are being made available at woreda and kebele offices. This process is commendable and should be continued whenever new documents or events make it relevant.

Compliance with International Good Practices

In the light of the above-described environmental and social issues, the ESIA process performed up to 2009 does not fully follow the various IFI's guidelines or directives.

The ESIR Consultant has screened the EIB, IFC, World Bank, AfDB, IHA and WCD provisions with respect to the Project activities and ESIA process. The main areas of concern are as follows.

During the planning process, the ESIA studies have not been carried out as part of the feasibility study process. Letting the feasibility study precede the ESIA studies prevented the project design team from considering the findings of the EIA team and from making effective use of these findings while preparing the feasibility study. Instead, the Project team had to accommodate the essential hydrological aspects later, by modifying the initial design and incorporating the specific middle-outlets for controlled floods.

In other words, the ESIA process has been initiated too late in the project cycle to allow for a relevant analysis of alternatives, against most international good practices (e.g. EU EIA Directive, WB OP 4.01, IFC PS1, WCD SP2, IHA Environmental Impact Assessment & Management).

The ESIA scope of work did not focus sufficiently on the Project's downstream effects on the Omo River riparian communities. As a consequence, a number of international principles and standards could not be applied with. For instance, the indigenous people in the Project affected area are located in the downstream area, mostly in the Omo flood plain. To comply with IFC PS 7 or WB OP 4.10 on Indigenous People, the ESIA process should have highlighted the potential impact of the project on the flood plain hydrology, where Indigenous Peoples are living, hence the need to prepare an Indigenous Peoples Plan that is based on the social assessment and draws on indigenous knowledge.

As underlined in the previous section, public disclosure of information is another area where the Project fails to comply with IFI's standards.

The transboundary aspect is another area for improvement. Although neither Kenya nor Ethiopia have signed the ESPOO convention, the issues involved on Lake Turkana are yet to be covered by an appropriate agreement between the two countries. This would be required anyway by the World Bank OP 7.50 International Waterways and the Article 21 of the 2009 EIB Statement of Environmental and Social Principles and Standards.

On the other hand, the environmental and social management undertaken by the Project team has shown some encouraging perspectives. For the project-affected area which has been properly covered by the ESIA investigations and mitigations (dam site, reservoir area and Chida-Sodo Road realignment), the environmental and social action is managed in accordance with best practices.

The Project will contribute to some of the Millennium Development Goals: Goal 1 (Eradicate extreme poverty and hunger) for the people living along the new Chida-Sodo Road but they also face potential negative impacts depending on success of resettlement and livelihood programme; Goal 2 (Achieve universal primary education) through contribution of some funds to filling of critical gaps in the educational sector. Goal 7 (Ensure environmental sustainability) through the promotion of hydroelectricity and the reduction of GHGs; Goal 8 (Develop a global partnership for development) through increased electrification of the country and increased export earnings from sale of electricity.

Institutional capability

Environmental management is provided by various organizations at different levels of decision making. ESIA documentation is reviewed and officially approved by the Impact Assessment Service of the National EPA. The staffing of this service (3 persons) is far below the requirements.

To manage Gibe III environmental issues, EEPCo has set up a team in the PIU in Addis Ababa and since November 2008, the Environmental Management Unit (EMU) on Project site. The role of the EMU is to ensure mitigation measures are implemented on the construction sites and to supervise and monitor the resettlement, compensation and livelihood improvement activities on going particularly along the realignment of the Chida-Sodo road.

EEPCo is presently implementing a second EMU in Jinka to supervise and monitor public consultation and mitigation measures anticipated for the downstream area.

On the Project Site, the EPC Contractor has established an HSE Department in charge or supervising and monitoring all activities related to health, safety and environmental management. The dedicated 35 staff includes 3 professional expatriates.

Monitoring of construction activities is provided on a routine basis by the EPC Contractor HSE Department, complemented by weekly sites visits of the EEPCo EMU, by monthly audit of an independent inspector appointed by the EPC Contractor and every 6 months by an Environmental specialist of the Supervision engineer.

For resettlement and livelihood improvement along the Chida-Sodo Road, EEPCo will establish a Resettlement Implementation Unit (RIU) with a total of eight staff to be responsible for day-to-day implementation. The RIU will liaise with Woreda and Kebele Resettlement Committees and strategic guidance will be provided by a Resettlement Steering Committee (RSC). While the membership of these committees reflects a holistic approach, there is a lack of female representation, which should be rectified. In general, the structure is appropriate, but it appears that the number of staff allocated to the RIU is insufficient. It is currently not clear whether monitoring will be carried out by the RIU (as stated in the RAP) or by EMU as maintained by the EMU Team Leader.

In the downstream area, implementation will be subcontracted to NGOs or other agencies with sufficient expertise and relevant experience in the area. This seems to be a realistic approach given the limited capacity of human resources in this field. Committees should be established at woreda and kebele levels to assist the implementing agency at local level. A specific monitoring unit is currently being established with one professional staff and a liaison person for each of the four main ethnic groups affected. This seems to be inadequate considering the issues and area to be covered. At this stage it remains uncertain whether the RSC will cover the downstream area as well or a separate committee will be established to provide policy guidance and advice.

Grievance Redress Committees have been established along the Chida-Sodo Road, while such structures still have to be developed in the Downstream Area. It should be ensured that women are represented in these, at least as on of the representatives for the PAPs.

Recommendations

Some mitigation measures proposed by the ESIA are questionable, as their content and purpose are not always clearly presented. The ESIR Consultant considers that measures related to the clearing of the reservoir, to the creation of the buffer zone and to the watershed management be reconsidered on the basis of a better identification of the purpose and of the objectives. The budget allocated to these tasks is significant and could be better re-allocated to more important tasks. In the downstream area, mitigation measures are simply presented as supporting packages for irrigation and livestock activities development. There is no information on the detailed content of these measures while a significant budget of about 18 million US$ is allocated.

The ESIR Consultant also recommends reconsidering the controlled flood mitigation as the unique solution and as it is designed in the ESIA-DS. Regarding the controlled flood, the ESIA has planned a solution without fully qualifying the problem and without studying its effectiveness which may be considered as a major weakness of the downstream mitigation plan. Alternative mitigation options should be considered which (i) ensure the long term preservation of the delta and (ii) optimize the social and economic benefits to be expected from the new hydrological conditions.

It is deemed necessary to reverse the intervention logic adopted so far. Until a clear understanding of the existing interrelations between the Omo river flow and the environmental and socio-economic conditions in the delta, it would be difficult (i) to propose the most effective solution for Omo river water management and (ii) to assess the cumulative effects resulting from the planned cascade of hydropower developments along the river.

The ESIR Consultant proposes that additional investigations are carried out in two major fields insufficiently addressed in the ESIA studies: (i) the hydrological and hydraulic assessment of the Omo river system, including particularly the lower Omo river reach to Omorate, the Omo delta and Lake Turkana, and (ii) the survey of the present socio-economic and ecological benefits from the Omo River in the plain and in the delta. When the results of these two fields of investigations are available, the Project will be able (i) to finalise the downstream impact analysis including cumulative impacts and impacts on Lake Turkana, (ii) to identify and analyze possible alternative mitigation measures , (iii) to produce a livelihood development plan taking into consideration the specificities of the ethnic minority groups living in the project-affected area, and (iv) to engage through an effective public consultation process about the proposed measures.

Among the priority measures, the ESIR Consultant recommends the immediate implementation of a river gauging station, near Omorate, in order to collect hydrological information on the lower Omo as soon as the coming rainy season 2010.

It is the sincere conviction of the ESIR Consultant that the Gibe III Project could be an exceptional opportunity to foster the economic development of the delta region, should a proactive and consultative development approach be developed, necessary to fully benefit from the changes induced by the Project. This should be preferred to the passive attitude adopted in the ESIA which intends only to restore, as much as possible, the poverty conditions which prevail at present, and which are reflected by permanent food insecurity.

Chapter 1. Introduction

1.1 Project Background

Overview

The Gibe III hydroelectric project (HEP) in Ethiopia is located on the Omo River, and is the lowest in a cascade of three schemes, although two more schemes are at a very preliminary stage of investigation further downstream. The two upstream schemes are Gilgel Gibe I (184 MW), which is operational, and Gilgel-Gibe II (420 MW), commissioned in January 2010. Gibe III is planned to be the largest hydropower project in Ethiopia with an installed capacity of 1,870 MW and an expected generation of 6, 400 GWh of energy per year at the generator terminals with average rainfall.

The promoter of the Gibe III HEP is the Ethiopian Electric Power Corporation (EEPCo), the state owned electricity utility, and they have entered into an Engineering, Procurement and Construction (EPC) turnkey contract with Salini Costruttori S.p.A of Italy (Salini).

The Dam site is located 300 km south west of Addis Ababa, and 50 km west of the town of Sodo. The distance from Sodo to the site by existing road is 80 km. This road is not paved but passable in all weather conditions. Road access from Addis Ababa is either via Mojo, Sashamene, Sodo and Bele, a distance of approximately 470 km, or via Butajira, Hosaina, Sodo and Bele, a distance of approximately 390 km.

The Gibe III scheme is currently under construction, but financing has yet to be finalized. As a consequence, the award of subcontracts has been delayed with the risk that the project drops behind schedule.

Project components

The Project includes the construction of a 240m high Roller Compacted Concrete dam (RCC). All power facilities, waterways and other structures are constructed on the left bank of the river.

The dam is a classic gravity RCC structure, with a central block which supports the central overflow spillway. The main characteristics are as follows: (i) Crest level: 896 m, (ii) Maximum /normal operating level: 892 m, (iii) Minimum operating level: 854 m, (iv) Overflow spillway level: 873 m, (v) Total crest length: 610 m, (vi) Overflow spillway length: 106 m, (vii) Maximum height above foundation: 243 m. The overflow spillway, is designed for a capacity of 10 600 m3/s.

The reservoir area created by the dammed river will be 209 km² and stretch along 150 km at full supply level.

The power waterways comprise two systems, each with an intake structure, a headrace tunnel, a surge tank and a vertical underground pressure shaft. The headrace tunnels are 660 and 870 m long respectively, and are designed with an internal diameter of 11 m.

The powerhouse is located on the left bank of the Omo River, about 500 m downstream from the dam axis. The building is located parallel to a steep rock face and broadly parallel to the river axis. This location has been chosen in relation with the geomorphology of the left river bank and to minimize the volume of the rock excavations. The powerhouse is a 250 m long reinforced concrete structure, housing the 10 generating units and associated equipment. Its upper deck, at el 702 m, supports the five banks of three single phase step-up transformers. Turbines comprise 10 Francis turbines rated with a net head of 190 m and a flow rate of 102 m3/s at rated head.

The 418 x 128 m switchyard is located on the left side of the river, on a plateau above the powerhouse at el 1010 m.

The power produced by the Project will be delivered to the Interconnected System through a 65-km-long four double circuit 400 kV overhead transmission line that connects the Gibe III power plant to a new substation at Sodo. A right-of-way, 50 m width, will have to be kept clear from both vegetation and structures.

New roads will replace the existing Bele-Lala road, that will be partially flooded by the reservoir, with 54 km on the left bank, starting from Bele, and 21 km on the right bank, starting near Lala. The two sections of the road will be connected by a new bridge being constructed across the Omo River, 1,100 m downstream of the dam.

Status of construction activities

According to the Contract Amendment of April 2008, which revised the initial contract dated July 2006, the first generating unit was to be commissioned early July 2012, with the last unit commissioned and the scheme fully completed 12 months later, i.e. in July 2013.

In December 2009, one third of the works was reported completed by the EPC Contractor, including the diversion of the river that had been made before the onset of the 2009 seasonal flooding. The excavation works of the dam and of the power house were in progress, but slightly behind schedule. The final design and the orders for the main equipment items were also behind schedule. However there will be a problem related to the dam construction, because the aggregate crushing and sieving plants, concreting plant and associated equipment, which will be needed for the dam construction were ordered late as a result of delayed funding.

According to the last schedule, which takes due account of the delayed availability of the main stationary plants and which has been recently updated, the concreting of the dam is due to start early October 2010, 15 months behind the revised schedule. The first unit is planned to be commissioned mid August 2013, and the dam fully completed by January 2015.

1.2 Scope of the Assignment

At the request of the government of Ethiopia, the European Investment Bank (EIB) is considering a possible support to the Gibe III Project. Prior to any decision, the EIB has appointed Sogreah Consultants (i) to conduct an independent review of the existing environmental and social impact assessment documentation, (ii) to address issues not or insufficiently covered in the studies, (iii) to provide a second opinion where required and (iv) to supplement, where feasible, any additional input deemed necessary.

The final objective of the independent review is the finalization of the assessment of the environmental and social impact of the project, which is criticized from many different angles by several international NGOs. Major criticisms focus on the downstream area where significant impacts from the project may affect ethnic minorities living on the flood plain and relying particularly on flood recession agriculture and livestock raising. Furthermore, the reservoir impoundment may have also significant impacts on the hydrology of Lake Turkana in Kenya, thereby raising transboundary concerns.

1.3 Independent Review approach

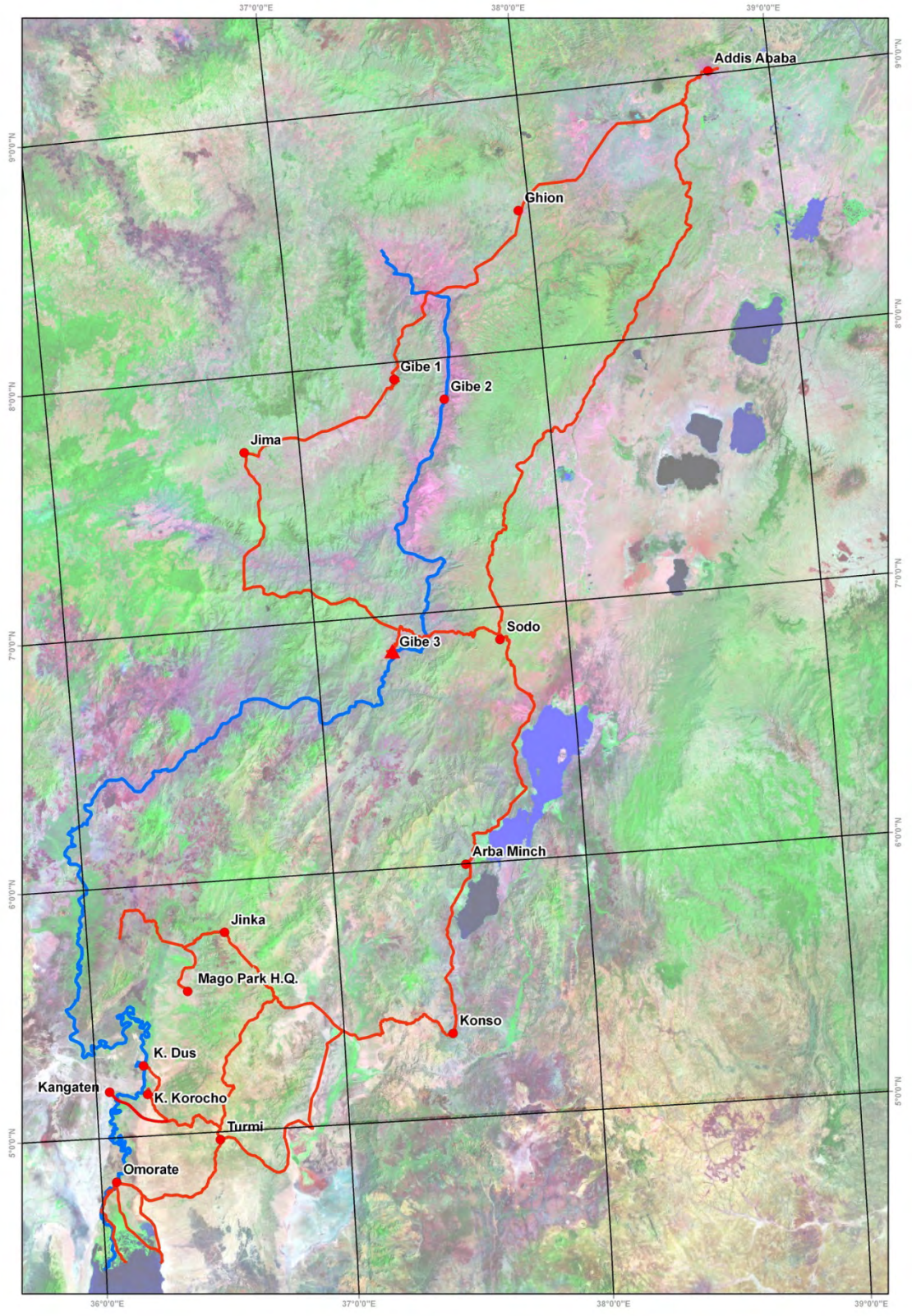
The overall approach for the environmental & social independent review has been a breakdown into three phases over 4 months: (i) Inception phase, (ii) Detailed review and analysis, (iii) Presentation and discussion of key issues.

Phase 1 covered the inception period. The Inception Report was the output of Phase 1. Its objective was to review the proposed approach in Sogreah's initial proposal, update the workplan to ensure its relevance and feasibility, and establish a common vision for the Banks / Promoter / Consultants regarding the nature of outputs and the procedure for validation of findings.

Phase 2 has been the actual heart of the review work. It has started by a desk-top analysis of documents collected during Phase 1 (see Appendix [1]). A field mission in Ethiopia has then been carried out to meet stakeholders (see Appendix [2]), including civil societies, visit the project-affected areas, and consult additional documents. The figure overleaf presents the route followed by the Independent Review Team within the project-affected area. On returning to Europe, the review team has prepared the present draft final report in accordance with the content agreed during the inception phase.

Phase 3 concerns the presentation and discussion on the key findings of the review to the lenders and to EEPCo.

Figure [1] - Route followed by the Independent Review Team within the project-affected area



Chapter 2. ESIA Process & compliance with international standards

2.1 ESIA process

The ESIA preparation started in 2005, and a first ESIA report was released the same year. The ESIA was only focussing on the construction sites zone, and was later complemented by a second ESIA dedicated to the downstream area (the Omo Plain and the delta).

The approval of the ESIA by EPA was issued the 23rd July 2008.

The final documents which are available on the website of EEPCo have been released in January 2009. The documentation produced during the process includes the following reports:

- Environment and Social Impact Assessment (ESIA).
- Environment and Social Impact Assessment, Chida-Sodo Road Realignment.
- Environment and Social Impact Assessment, Gibe III – Sodo 400 kV Power Transmission Lines Project (ESIA-TL).
- Environment and Social Impact Assessment, Additional study on downstream impact (or ESIA-DS).
- Environment and Social Management Plan (ESMP).
- Resettlement Action Plan (RAP), Main Report and annexes 1-12. A revised version was made available to the ESIR Consultant in December 2009.
- Resettlement Action Plan, Sodo 400 kV Power Transmission Lines Project (RAP-TL).
- Public Consultation and Disclosure Plan (PCDP).

2.2 Alternatives Analysis

The ESIA does not examine alternative energy production systems, but limits the analysis of alternatives to various dam layouts strictly technical.

However, the economic analysis of the Gibe III project was performed as soon as 2005 by the EPC Contractor in order to compare the newly identified Gibe III alternative with the portfolio of hydropower projects presented in the 2005 EEPCo Master Plan. This analysis was reviewed in the EFTA report which concluded that :

- Gibe III costs appear in line with costs of alternative portfolio of project providing the same energy;
- Gibe III offers additional potential benefits of simplifying project development and providing a faster delivery as one large scheme only instead of several smaller projects is more easy to manage;
- EIRR calculated by the EFTA Consultant using the willingness to pay and the marginal productivity of electricity give even higher returns than alternative generation portfolio.

The EFTA report provided also an economic comparison of Gibe III with alternative non-hydro generation portfolio including several generation technologies: Medium Speed Diesel, Open Cycle Gas Turbine (fuel oil and natural gas), Combined Cycle Gas Turbine (natural gas fired), coal (ethiopian and import coal), Wind Power (in Ethiopia), Concentrating Solar Power, Solar Photovoltaic, Geothermal (in Kenya) and Kenyan hydro schemes.

As a result, and including mitigation costs for environmental and social impacts (40 million US$), Gibe III EPC cost compares favourably with alternative generation options, despite a higher capital cost but mainly because its low running costs and long plant life.

2.3 Compliance with International Reference Standards

The ESIA process performed up to 2008 does not fully follow the various IFI's guidelines or directives.

The ESIR Consultant has screened the EIB, IFC, World Bank, AfDB, IHA and WCD provisions with respect to the Project activities and ESIA process. The main areas of concern are as follows.

During the planning process, the ESIA studies have not been carried out as part of the feasibility study process. Letting the feasibility study proceed, the ESIA studies prevented the project design team from considering the findings of the EIA team and from making effective use of these findings while preparing the feasibility study. Instead, the Project team had to accommodate the essential hydrological aspects later, by modifying the initial design and incorporating the specific middle-outlets for controlled floods. In other words, the ESIA process has been initiated too late in the Project cycle to allow for a relevant analysis of alternatives, against most international good practices (e.g. EU EIA Directive, WB OP 4.01, IFC PS1, WCD SP2, IHA Environmental Impact Assessment & Management).

The ESIA scope of work did not initially focus on the Project's downstream effects on the Omo river riparian communities. As a consequence, a number of international principles and standards could not be applied with. For instance, the indigenous people[1] in the Project affected area are located in the downstream area, mostly in the Omo flood plain. To comply with IFC PS 7 or WB OP 4.10 on Indigenous People, the ESIA process should have highlighted the potential impact of the project on the flood plain hydrology, where Indigenous Peoples are living, hence the need to prepare an Indigenous Peoples Plan that is based on the social assessment and draws on indigenous knowledge.

As underlined in the previous section, public disclosure of information is also an area where the Project fails to fully comply with several IFI's principles and with the UNECE Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters (called Aarhus Convention, entered into force in 2001, signed by EU Member Countries and the EU). The provisions of the Convention i) oblige public authorities to hold basic information on the environment and share it with all citizens, ii) entitle the public - individuals and environmental organisations - to participate in environmental decision-making and provide comments and iii) enables citizens and environmental NGOs to act as "environmental watchdogs" by granting them the right to go to court in cases of failure to apply environmental law.

The Convention, which concerns mainly the European region, has been ratified by only 5 EU members and 21other Eastern and Central Europe countries members of UNECE. No African country has ratified yet the Convention. However, the ambitious objectives of the Convention regarding public participation could be appropriately substituted for the present Gibe III Project by the principles of disclosure policy of the World Bank, easier to implement in Ethiopia.

The transboundary aspect is another area for improvement. ESPOO is the convention on environmental impact assessment in a transboundary context. The Convention came into force on 10 September 1997. At the end of 2009, 47 countries had signed and/or ratified the convention. ESPOO Convention requires the Promoter to carry out a full EIA of the transboundary effects of the concerned project, to organize consultation of the transboundary affected parties and to reflect in the EIA the outcomes of the consultations.

Although Kenya and Ethiopia are not signatory parties of this convention, the transboundary issues concerning Lake Turkana, which are reviewed in this report, must be addressed following the best practice defined by the Convention. The ESIR Consul-tant recommends such an EIA to be a component of an additional study package still to be performed prior to a decision by the Lenders.

The Lower Omo Valley was classified in 1980 as a Unesco World Heritage. Indeed, the classified site concerns mainly the region of Gemu Gofa where the discovery of humanoid fossils and the evidence of the oldest known humanoid technical activity were achieved in the seventies. The site is included in the World Heritage list under criteria 3 (to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared) and criteria 4 (to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history). The site is not listed for natural/biodiversity purposes.

Ethiopia has not ratified the Ramsar Convention, and no registered site exists in the country. Kenya is a member of Ramsar, but Lake Turkana system is not registered as a Ramsar Site. Omo delta and Lake Turkana (Ethiopian part) area is listed as one of the 69 important bird areas identified in Ethiopia by Birdlife International, under the reference ET069. The fact sheet mentions that very few is presently known of the delta vegetation and of the bird species, except the fact that 350 species were recorded from around lake Turkana in Kenya and that so far only 64 species have been identified on the Ethiopian side.

The ESIA does not provide a Cumulative Impact Assessment (CIA) of Gibe III with the existing Gibe I and Gibe II upstream and the planned Gibe IV downstream. This analysis is recommended by the ESIR Consultant as a component of the proposed study package.

However, the environmental and social management undertaken by the EEPCo Project team has shown also some encouraging perspectives. For the project-affected area which has been properly covered by the ESIA investigations and mitigations (dam site, reservoir area and Chida-Sodo Road realignment), the environmental and social activities and in particular public consultation are managed in compliance with best practices.

2.4 Compliance with Ethiopian ESIA Procedures

A major criticism formulated by the civil society is related to the fact that the construction of the Gibe III project started before the ESIA approval by the EPA, which is an evident breach with the relevant Law. Indeed, construction works started in 2006, while the ESIA was officially approved by EPA on 23rd July 2008. Copy of the approval letter from EPA is provided in Appendix [4].

[1] In World Bank terminology, Indigenous Peoples refers to groups with the following characteristics (OP 4.10):

(a) self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;

(b) collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;

(c) customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and

(d) an indigenous language, often different from the official language of the country or region.

Hence the term covers the ethnic minorities in the Lower Omo Zone even if they are not indigenous to the area. In this report, Indigenous people and ethnic minorities are used interchangeably.

The approval of EPA came with a number of conditions regarding the implementation of the EMP measures. Most of the conditions imposed were rather general, and are satisfied by EEPCo. However, it seems that one condition, related to the organization of joint field monitoring involving "EPA and other stakeholders" has not yet been satisfied according to the EPA Impact Assessment Service.

An Environmental Advisory Panel has been set up for the Gibe III Project. It includes 8 members from the University, NGOs and the EPA. According to the EPA, this Panel has been established in July 2009. It is difficult to evaluate if this breach of the regulation had impacts on the project design. As the project has recently been revised (to shift from rock-fill dam to RCC dam), the revision of the design included two middle outlets to allow for the release of controlled floods. These facilities could have been decided earlier if the ESIA had addressed the downstream impacts at that time.

2.5 Project Contribution to Millennium Development Goals

In September 2000, building upon a decade of major United Nations conferences and summits, world leaders came together at United Nations Headquarters in New York to adopt the United Nations Millennium Declaration.

They committed their nations to a new global partnership to reduce extreme poverty and setting out a series of time-bound targets - with a deadline of 2015 - that have become known as the Millennium Development Goals (MDGs). Development projects and large investment projects with funds from countries that have signed up to the MDGs should contribute to these (or at least some of these). Many multilateral development organisations have also included the MDGs in their development objectives. It should further be ensured that projects are not counterproductive to the MDGs.

Whereas is it is impossible to quantify the potential contribution to the MDGs from the Gibe III Project, an attempt is made to assess whether the project is contributing positively, negatively or not at all to the various goals (see Table [1], next page).

Table [1] - Project Contribution to Millennium Development Goals

Goals	Targets	Potential contribution from Gibe III
Goal 1: Eradicate extreme poverty and hunger	Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day. Target 2: Achieve full and productive employment and decent work for all, including women and young people. Target 3: Halve, between 1990 and 2015, the proportion of people who suffer from hunger.	Target 1: Positive effect for households benefiting from the new Chida-Sodo Road. Negative effect due to project impacts. Effectiveness of livelihood programs in various project areas will determine whether these can be turned into project benefits. Target 2: Apart from temporary employment for a few people in the project area, the project will not contribute to this target. Target 3: With a successfully implemented livelihood program along Chida-Sodo road, the project will contribute to this target. In the downstream area, where many people already suffer from hunger, project contribution to the target will again depend on proper design and implementation of livelihood program.
Goal 2: Achieve universal primary education	Target 1: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.	The project will contribute to a limited extent through the social development program, i.e. filling of critical gaps in terms of class rooms, toilets, equipment, etc.
Goal 3: Promote gender equality and empower women	Target 1: Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015.	No specific contribution on this target.
Goal 4: Reduce child mortality	Target 1: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate.	No specific contribution on this target although general health support will benefit this group as well.
Goal 5: Improve maternal health	Target 1: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio. Target 2: Achieve universal access to reproductive health.	Target 1: No specific contribution on this target. Target 2: No specific contribution on this target.
Goal 6: Combat HIV/AIDS, malaria and other diseases	Target 1: Have halted by 2015 and begun to reverse the spread of HIV/AIDS. Target 2: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it. Target 3: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.	Target 1: The project will lead to increased risk of HIV/AIDS. Clinics and awareness campaigns are in place to address this risk. Target 2: Apart from staff at Gibe III construction sites, the project will not contribute to this target. Target 3: The potential impact from the project on malaria uncertain. However, project funds are set aside to address the issue.
Goal 7: Ensure environmental sustainability	Target 1: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources. Target 2: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss. Target 3: Halve, by 2015, the proportion of people without sustainable access to safe drinking water. Target 4: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.	Target 1: Hydroelectricity is the most widely developed renewable energy in the world. It contributes to sustainable development by reducing dependence on fossil energy and, as presented in the report, by significantly reducing the GHG released in the atmosphere. Target 2: No specific contribution on this target. Target 3: Areas along the new Chida-Sodo road without clean drinking water will be assisted. No specific assistance in the downstream area. Target 4: No specific contribution on this target.
Goal 8: Develop a global partnership for development	Target 1: Address the special needs of least developed countries, landlocked countries and small island developing states. Target 2: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system. Target 3: Deal comprehensively with developing countries' debt. Target 4: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries. Target 5: In cooperation with the private sector, make available benefits of new technologies, especially information and communications.	Target 1: The project is contributing to electrification of the country. Target 2: No specific contribution on this target. Target 3: The project will export up to half the electricity and thereby increase foreign exchange. Target 4: No specific contribution on this target. Target 5: No specific contribution on this target.

Chapter 3. Environmental & Social Organization

3.1 Organization

Environmental Protection Agency

The Environmental Protection Authority (EPA) was created in 1995 and re-established in October 2002, under Proclamation 295/2002. It is an autonomous government body reporting directly to the Prime Minister. Its mandate covers environmental matters at federal level. The objective of the EPA is to formulate policies, strategies, laws and standards which foster social and economic development and to spearhead in ensuring the effectiveness of the process of their implementation.

The EPA has regional representations dealing with projects of regional scale and without trans-regional implications. For major projects with trans-regional effects, federal level EPA has the responsibility of ESIA review and approval.

Within EPA the Impact Assessment Service (IAS) is in charge of ESIA related aspects including (i) the production of ESIA guidelines and (ii) the review of ESIA reports. The human capacity of the federal EPA-IAS is limited to only 3 persons (a limnologist – Director, one human ecologist and one agriculture-GIS specialist. It is obvious that staffing is not in accordance with needs, even if the Service benefits from the support from other departments for the ESIA review work. According to legislation, the EPA must provide its comments on an ESIA within 15 days of report submission.

These conditions contribute partly to the weakness of the institution when confronted to major projects as Gibe III, and to the fact that a project implementation may start even before the official approval is released.

EEPCo PIU and EMU

In Addis Ababa, Gibe III Office EEPCo has recently established a Team called E&S PIU in charge of coordinating all E&S issues related to Gibe III Project. This body includes 3 persons, one Environmental Engineer (Coordinator), one Public Relation Officer and one IT Specialist. This team is in charge of coordinating E&S issues between the EEPCo EMU which is on site and the various EEPCo Departments of the Gibe III PIU as well as other central government agencies.

Since November 2008, EEPCo has established the Environmental Monitoring Unit (EMU), based on GIBE III site, to address environmental matters arising from its development program. The EMU is presently limited to 3 persons, its Team Leader (Sociologist), one sociologist and one Environmentalist. The EMU has neither dedicated secretarial services nor vehicle.

In theory, the responsibilities of the EMU cover all environmental and social concerns in the upstream area during project preparation and construction:

- Conduct or supervise environmental assessment for EEPCo;
- Ensure that mitigation measures, conditions and specifications are fully implemented during construction and resolving problems as encountered;
- Supervise restoration of construction area to its natural state that was affected during construction period of a project;
- Facilitate and ensure compensation payment for material damage in the implementation of power projects;
- Monitoring proper implementation during resettlement and post-resettlement of communities;
- Submit ESIA and other environmental review documents to EPA for review and approval and make clarification upon request;
- Conduct and supervise community safety program around electric power lines, plants, etc., and monitor its implementation;
- Conducting periodic environmental monitoring during construction activities (dumping areas, health and safety, discharge of untreated water, dust pollution etc.);
- Advise on environmental and social issues for EEPCo;
- Represent EEPCo in watershed management with GO's and NGO's for hydropower projects and hydropower plants;
- Conduct and supervise buffer zone management in hydropower projects and plants (reforestation, soil conservation, wild life restoration, activities, etc.);
- Controlling water hyacinth, proliferation of aquatic weeds, and conduct water quality tests in hydropower projects and plants;
- Monitor reservoir forest clearing operation before impoundment.

Practically today, the main tasks of the EMU concentrate on:

- Monitoring of Project construction activities & facilities through 2 site visits per week;

• Collaboration with NGOs for HIV/AIDs prevention among project site workers;

• Participation once a month to the Joint Site Visit with EPC Contractor HSE and the Independent H&S Inspector;

• Preparation of a monthly report to PIU.

As mentioned below, the EMU is also responsible for monitoring of resettlement, compensation and livelihood improvement activities which are starting soon along the Chida-Sodo road. This will be a major activity, and the ESIR Consultant is sceptical about the future of the construction site monitoring presently performed by EMU, because of the cumulated workload. **Reinforcement of staff must be considered by EEPCo.**

Presently, EEPCo is establishing a second EMU in Jinka (downstream area), to initiate communication with the communities and coordination with agencies prior to start the social development program proposed in the ESIA-DS. This Jinka Unit will include one Sociologist (Team Leader), four ethnic group representatives (from Dasenech, Karo, Nyangatom and Mursi - still to be recruited) and one secretary.

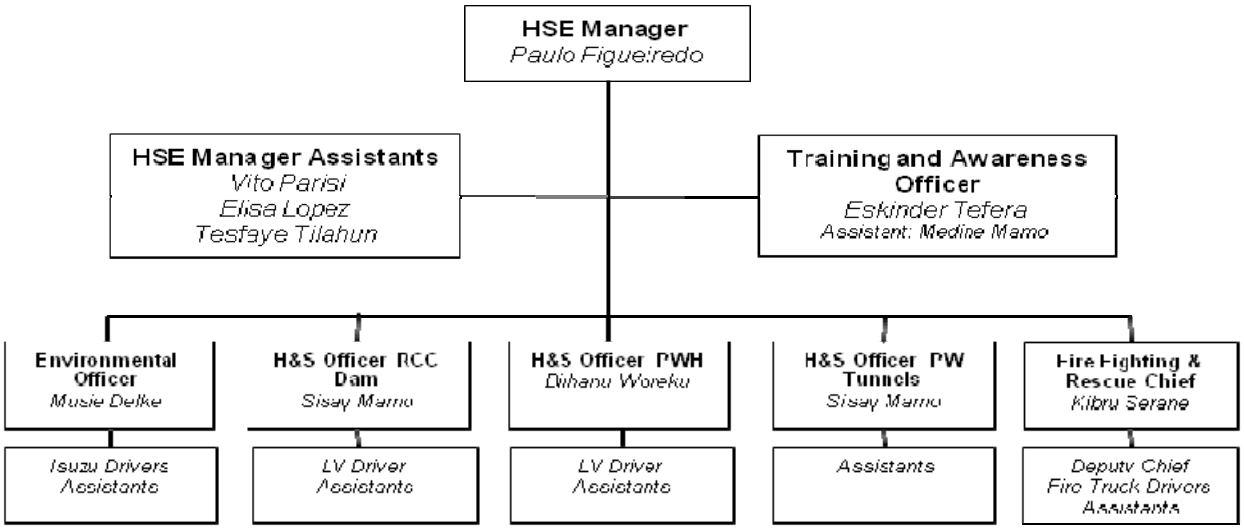
EPC Contractor Organization

The EPC Contractor has established a Health, Safety and Environment (HSE) section which includes 3 international and 32 national staff. The organization includes 5 departments, one for Environmental Management, 3 for Health and Safety (one for each major construction area: dam site, powerhouse and tunnels) and one for fire fighting and rescue operations. An independent unit is in charge of training and awareness for all aspects related to HSE.

The HSE department has its own offices and vehicles as well as its own workshop to produce equipment required for its activities: effluent treatment facilities, road and safety signs, distribution boxes for condom etc.

This organization is summarized in the following chart.

Figure [2] - EPC Contractor HSE Department Organization



Source: EPC Contractor

Resettlement Steering Committee

It is planned to establish a Resettlement Steering Committee (RSC) to provide policies, guidelines and advice for implementation of the project. The RAP has outlined an indicative list of roles and responsibilities:

• Provide overall policy guidance and oversee the process of implementation of the RAP;

• Ensure that the RAP is implemented in accordance with the policies and laws of the country and the principles, approaches and timetable embodied in the RAP;

• Ensure that the rights and entitlements of the PAPs are safeguarded and the land acquisition and compensation, relocation and resettlement, and income restoration and social development activities are carried out in a transparent and just manner;

• Ensure that that all organizations and agencies at various levels discharge their responsibilities for the implementation of the RAP fully and effectively;

• Hold periodic meetings and review progress of implementation of the RAP and based on these reviews and analysis identify gaps, challenges and problems and provide corrective measures;

• Take any and all other higher level decisions and actions necessary for the effective and timely implementation of the RAP.

The RSC will as a chair person have a representative from EEPCO. A representative of the Southern Nations and Nationalities and Peoples Region (SNNPR) Council will serve as a co-chair. In addition, the RSC will as members have representatives from regional, zone and woredas in the project affected area, i.e. in Wolayta and Dawro Zones.

The RSC does not at this stage include representatives from South Omo Zone and the four woredas affected by downstream impacts. It should be considered whether a separate committee would be more relevant than adding such members to the RSC.

Table [2] - Composition of the Gibe III HEP Resettlement Steering Committee

1	Ethiopian Electric Power Corporation	Chair Person
2	Representative of SNNPR Council	Co-Chairman/Member
3	Coordinator/Head of the RIU	Secretary
4	Representative of SNNPR BoARD	Member
5	Representative of Wolayta Zone Council	Member
6	Representative of Dawro Zone Council	Member
7	Representative of Kindo Didaye Wereda Administration	Member
8	Representative of Kindo Koysha Wereda Administration	Member
9	Representative of Loma Wereda Administration	Member
Total		9

3.2 Construction activities: Monitoring & reporting

On site, construction activities are monitored at 3 different levels: (1) EPC Contractor, (2) EEPCo and (3) Independent Monitor.

Monitoring & reporting by EPC Contractor

Monitoring is performed by the HSE Staff. Monitoring of construction activities is carried out on a daily basis. Non-compliance detected by an inspector is discussed on site with the construction foreman/supervisor and/or reported to the HSE Manager for eventual action if justified.

On a monthly basis, the Site HSE Manager produces an HSE activity report submitted to the EPC Contractor Head Office. The report provides the following:

• HSE documentation produced during the period and submitted to the Employer Representative (EEPCo); approved documents during the period and list of documents under preparation or revision;

• HSE performance during the period, based on various criteria: Safety Indicators, accident analysis, HSE notices produced, HSE expenses and investments, environmental indicators;

• Measures implemented within the context of risk management;

• HSE implementation status: on-site implementation during period, proactive indicators, training report, photographs of activities;

• Future HSE implementation program intended for the next period;

• Other activities & concerns.

The safety indicators concern those traditionally on large construction sites: number of fatalities during period, number of Lost Time Injuries (LTI), number of lost working days, number of road traffic accident (RTA), and number of kilometers driven during the period.

Environmental indicators include: clearing and revegetation areas, topsoil volumes removed, stored and reused, quarry and borrow areas, quantities of non-hazardous waste produced, recycled and disposed, quantities of hazardous waste produced, recycled, incinerated and disposed, quantities of diesel used, number of accidental spills registered.

Proactive indicators mainly relate to HSE proactive activities: number of HSE training hours, toolbox talks, safety observations, HSE meetings and audits, number of water analysis, noise measurements, air quality measures (underground), and vibration measurements.

Monitoring and Reporting by EEPCo EMU

Every week, the EMU, based on the construction site carries out on average 2 visits to the sites: construction and workshop areas, canteens, slaughter house, waste facilities, and site restoration activities.

The EMU produces a monthly Environmental Report submitted to the PIU in Addis Ababa, which content is similar to the monthly environmental inspection report described in the next section.

Monitoring and Reporting by the Supervision Engineer

An Environmental Audit of the construction sites is performed every 6 months by a specialist of the Supervision Engineer (Electroconsult & Coyne et Bellier). The report is submitted to EEPCo.

Monitoring and reporting by independent inspector

Upon request by EEPCo, the EPC Contractor has appointed an independent consultant to perform a monthly site visit and reporting. The appointed consultant is Mid-Day Consulting Engineer, which has already an extensive knowledge of environmental issues in the area. The Consultant performs **a joint visit**, with EEPCo-EMU and EPC Contractor HSE Site Manager. During the visit, all sites are investigated and HSE documents produced during the period reviewed.

The report produced by the Independent Inspector covers the following: quarry sites, spoil disposal, access roads, collection & disposal of waste (domestic, medical, other solid waste), sources of pollution (used oil storage & disposal, effluents from batching plants, chemicals used on work sites), air pollution issues (dust), sanitation and health issues (services, malaria control, HIV/AIDS and other STIs), water supply, occupational safety, site restoration, spontaneous settlements, benefits to local communities, tensions between workers & local communities, annexes when justified).

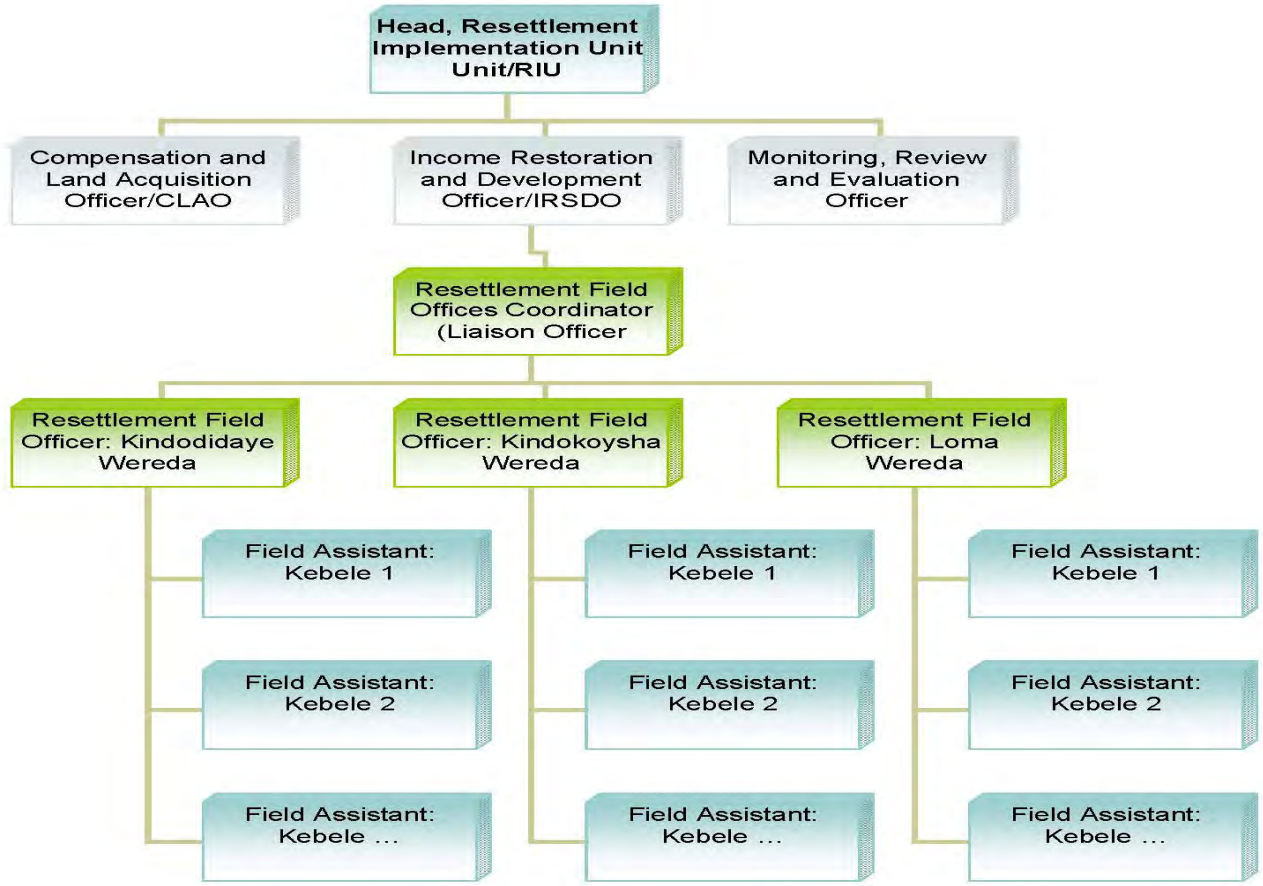
3.3 Resettlement & Compensation for Reservoir, Chida-Sodo Road & Permanent Camp

Implementation

Resettlement Implementation Unit (EEPCo)

For efficient implementation of the RAP, the EEPCo is about to establish a Resettlement Implementation Unit (RIU), see Figure below.

Figure [3] -Structure of the Resettlement Implementation Unit



The responsibilities of the RIU are presented as:

- Organize its office, supplies and equipment and prepare the necessary documentation and data base system;
- Study in detail the RAP, and based on the review of the RAP prepare a detailed action plan and time table for the day to day RAP implementation;
- Organize the necessary training and capacity building measures for the unit itself and for other partner organizations and committees;
- Organize resettlement field offices (RFO). Recruit, train and assign resettlement field officers and assistant field officers;
- Establish all local level institutions and committees which will participate the implementation of the RAP and provide them with the necessary training and capacity building measures;
- Undertake compensation and land acquisition activities in accordance with the principles and procedures specified in the RAP
- Implement the income restoration and social development programs and project in accordance with the principles and procedures specified in the RAP;
- Supervise the work of resettlement field offices and workers through frequent travel to the field;
- Ensure the systematic undertaking of monitoring, review and evaluation of the RAP in accordance with the framework and guidelines provided in the RAP and store the data and information collected in a data base;
- Based on the findings of the monitoring and review take corrective actions and submit monitoring and review reports to the relevant higher bodies for timely corrective measure

To implement this well-defined TOR, the following staff will be allocated to the RIU:

- RIU Manager/Coordinator
- Compensation and Relocation Officer
- Income Restoration and Social Development Officer
- Monitoring, Review and Evaluation Officer
- Secretary

In addition there will be a Resettlement Field Officer allocated to each of the three main affected woredas.

As the responsibility for day-to-day implementation is vested with the RIU and considering the task outlined for it, it appears that the unit is severely understaffed. Even though activities will be carried out in collaboration with government officers at woreda and kebele levels, the guidance and supervision will have to come from the RIU. EEPCo should be prepared to allocate additional staff as activities build up.

Woreda Resettlement Committee

Woreda Resettlement Committees (WRCs) have been established in two of the three woredas affected by the reservoir, road realignment and permanent camp (i.e. Kindo Koysha and Kindo Didaye). The WRC in Loma Woreda is currently being established along with committees in the kebeles affected there.

The roles of the committees are defined as:

- Take the lead role in land acquisition and compensation activities in their respective Woredas.
- Mobilize and guide government line office to fully participate in the implementation of the RAP.
- Mobilize PAPs and communities and provide guidance and assistance for the implementation of income restoration and social development project of the RAP (Internal document from Gibe III EMU on Resettlement and Grievance Committees (no title)).

The composition of the WRC reflects the holistic approach the project is taking with representation of all relevant line development offices. In addition there are representatives from a micro-finance institution and a NGO working in the woreda. Finally, the committee is meant to have two members representing the PAPs. A stipulation ought to have been included that these two latter representatives should be one male and one female.

The two WRCs established so far have unfortunately only one representative of PAPs each (both men). In addition, the representative of the Women Affairs Office in Kindo Koysha WRC is a man (allegedly, it was not possible to find a qualified woman). **This issue should be addressed as implementation of resettlement and livelihood activities as well as compensation should pay attention to men as well as to women**.

Table [3] - Composition of Woreda Resettlement Committees.

1	Representative of Woreda Administration	Chair
2	Representative of Woreda Office of Finance and Economic Development	Vice-Chair
3	EEPCO Resettlement Field Officer	Secretary
4	Representative of Woreda Office of Agriculture and Rural Development	Member
5	Representative of Woreda Office of Health	Member
6	Representative of Woreda Office of Education	Member
7	Representative of Woreda Office of Rural Roads	Member
8	Representative of Woreda Office of Women Affairs	Member
9	Representative of micro-finance institution operating in the woreda	Member
10	Representative of an NGO operating in the woreda	Member
11	2 representatives of PAPs	Members

Kebele Resettlement Committee

It is recognized in the RAP that the kebele administration (or Peasant Association, as it was called in the past) traditionally has lacked the financial, staff and office capacity to act as implementers of development activities. However, the RAP authors see some changes and "encouraging development due to initiatives related to decentralization and strengthening of local institutions".

The Kebele Resettlement Committee (KRC) is being established in each project affected kebele to work closely with the WRC and RIU to "ensure easy and quick communication with PAPs and their effective participation in the implementation of the various activities of the RAP." A more detailed list of roles and responsibilities will be needed to enhance the KRCs role in implementation of the RAP activities.

There is some confusion with regard to the composition of the KRC. The RAP has presented the KRC with five members:

Table [4] - Composition of Kebele Resettlement Committee.

1	Representative of Kebele Administration	Chair
2	Kebele Agriculture Extension Worker	Secretary
3	Community Elder	Member
4	2 Representative of PAPs	Members

whereas the 10 kebeles established so far have the following additional five members:

5	Kebele Health Extension Worker	Member
6	Director of Kebele School	Member
7	Kebele Women's Affair Officer	Member
8	Chair of Kebele Land Administration Committee	Member
9	Representative of Kebele social court	Member
	Total	10

This is a positive addition to the recommendation from the RAP as it better reflects the need of local expertise in the resettlement and livelihood improvement process. The KRCs typically have 2 female out of the 10 members: 'Women's Affairs' and 'Health' and in one kebele an 'Agriculture Extension Worker'. The two PAP representatives are in all 10 KRCs male. The ideal here is also to have a male and a female representative.

Monitoring

The Gibe III EMU (Site Unit) is also responsible for motoring of resettlement, compensation and livelihood improvement activities. The staffing of three professionals (two sociologists and one environmentalist) will not be adequate in the future when the resettlement and compensation process will start, taking into consideration that the team is also responsible for monitoring of environment aspects of construction activities.

3.4 Livelihood & Social Development Implementation and Monitoring – Downstream

The approach for mitigation and compensation taken in the ESIA-DS is "wait and see", i.e. first monitoring of the environmental impacts. The recommended organizational structure is therefore shaped around monitoring with some unconditional assistance to vulnerable groups. However, it is admitted that there could be some impacts on riverine communities:

- "Possible household's income reduction (there is a very small economy and money flow. The quantity of products exchanged will decrease) and food shortages;
- Possible rapid change of traditional lifestyle and production systems; and
- Possible increasing human and livestock pressure on the riverine area and consequent conflicts".

It is beyond doubt that there will be an impact for the people dependent on the Omo River, even with the artificial flow. What remains uncertain is the scale of this impact. As mentioned above, a branch of EMU is being established in Jinka for monitoring purposes.

It is the plan to sub-contract implementation activities to local NGOs or other agencies with experience in the area. The reasoning being that this is the only way to get qualified staff to do the job. This assessment appears to be realistic. However, the ToR and budgets for these contracts remain to be developed and would realistically have to depend on more detailed studies on the technical feasibility and preferences of the various livelihood options presented.

3.5 Grievance Redress Mechanisms

The grievance mechanism established has its focus at the kebele level as a PAP with a grievance will have to present his/her case to the KRC. If no satisfactory decision is obtained here, the PAP can refer the case to the GRC at kebele level. Should the PAP not agree with the outcome, a case can be filed at the regular court. It is not clear whether this court belongs to the kebele or woreda level. The result from the court is final.

Committees to handle grievances among PAPs and other stakeholders have been established at kebele level in Kindo Koysha and Kindo Didaye Woredas along the Chida-Sodo realigned road. In Lomo Woreda, Grievance Redress Committees (GRCs) are presently being established in the affected kebele there.

The role of the GRC is to:

- Resolve disputes and conflicts associated with the implementation of the project and RAP.
- Hear the grievance of PAP's and other stakeholders and arbitrate disputes in order to arrive at amicable solution based on negotiation in a transparent and fair manner.

The GRC will be composed of people representing the kebele administration, the judicial system, respected community elders and the PAP. There is no stipulation towards gender representation. However, in half of the GRCs the PAP representative is a woman and three out of 10 committees are chaired by women.

Table [5] - Composition of Grievance Redress Committee.

1	Representative of Kebele council	Chair
2	Representative of kebele social court	Secretary
3	2 respected community elders	Members
4	Representative of PAPs	Member
	Total	5

Grievance Redress Committees are yet to be established in the downstream area. These should be in place by the time of first project impact, i.e. impoundment. Female representation should be ensured and a proper set of roles and responsibilities should be developed.

Chapter 4. Baseline Situation

4.1 Sources of information

The main sources of information used by the ESIR Consultant include:

- The ESIA Documentation from EEPCo;
- The EFTA Report for selected aspects (geology, hydrology);
- The Omo-Gibe River Basin Integrated Development Plan;
- Documentation provided by the EPC Contractor;
- Documents collected in Addis Ababa and on site during the field visit of the downstream Omo;
- The reports put on the web by the NGOs;
- Several scientific and social research publications.

The comprehensive list of documents used for this study is provided in Appendix [1].

Several resource persons have also been interviewed by the ESIR Consultant. The list of these persons is provided in Appendix [2].

4.2 Environmental Baseline

Geology & Seismicity

Geology

Information on geology and seismicity is provided in the specific design reports[2] from which a significant part was presented in the ESIA.

The Omo-Gibe Basin occupies the Omo and Usno rift valleys which are considered as northern extensions of the Lake Turkana-Ethiopian rift system. In the northern part of the Basin rivers have exploited the major fault zones to cut deep gorges while the eroded material has been deposited in the lower part of the Omo basin as a sequence of quaternary alluvial deposits of over 3000 m thickness.

The Omo-Gibe River basin consists of Precambrian crystalline basement (about 11% of the Basin), Tertiary volcano-sedimentary rocks overlain by felsic lavas and pyroclastic materials (about 80% of the Basin), Quaternary alluvial and lacustrine deposits and recent volcanic cover.

Reservoir area

According to the L1D Geological Report, the riverbed and in general the lower part of the reservoir consists of basalt flows and minor ignimbrite and tuff levels, while the upper part of the reservoir will rest on trachytes, rhyolites, ignimbrites and tuffs. Plugs and dikes of rhyolite, trachyte, phonolite and microgranite are reported along the valley slopes.

Dam site

The Gibe III Project site is located in the Jima volcanic formation. In the project area, the formation comprises trachytes, basalts and pyroclastic materials. The dam site area is located in a deep gorge with sub-vertical walls. Alluvium is present in the river valley and colluvium on the lower slopes of the valley. The dam area is characterised by a massive trachyte unit, overtopped by a basaltic unit consisting of two main basaltic and trachi-basaltic flows with inter-bedded pyroclastics and continental deposits (ancient alluviums). At the top of these rocks lies a sedimentary/volcanic series comprising pyroclastics, ashes, ignimbrites and ancient alluviums. A volcano sedimentary unit has been found beneath the trachyte in a series of boreholes upstream of the dam. A 1-2m thick layer of black clay with evidence of shearing is found at the interface between the trachyte and underlying mudstones and sandstones. The setting is similar on both sides of the Omo valley, though the thickness and the position of some of the units vary.

Alluvium 15 to 17m in thickness is associated with the river. This typically comprises cobbles, gravels and sand and is predominantly basalt in origin. Colluvium is present on the lower slopes of the gorge and is trachyte or basalt depending on the rocks above. It varies in size from silt to boulders.

Lower Omo

Lower Omo geology is characterized by its rock formations and sediment deposits.

The rock formations (Hammar Domain) form the crystalline basement which underlies the lower part of eastern Omo River area and the northern part of Lake Turkana. They include two Precambrian major rock groups, a complex of older gneiss and granulite and a suite of younger plutonic rock not necessarily related to each other. This basement is covered by the pre- and post-rift sediments and volcanic materials represented by 4 formations:

[2] 300/GEO/R/SP001-Geological Report; 300/GEN/R/BR/001-Seismic Hazard Assessment;

• The Main Volcanic Sequences (Eocene, Oligocene), which rim the western side of the lower and middle Omo valley (up to the Jbai range) and the inner part of the eastern side to the east of the Mursi Plain.

• The Mursi formation basalt, which covers the eastern part of the mid-Omo valley (Mursi Plain). The Mursi Fm is divided into two units, the lower being sedimentary (some 150m of clays, silts and sand with subordinate tuff and pebble beds) and the upper one formed by flood basalt of a total thickness probably less than 100m.

• The Shungura formation (Pliocene) along the west side of the Omo River north of Lake Turkana, which includes 760m of brown, grey, and buff clays, silts, sand, gravel, tuffs, marls and freshwater limestone.

• The Nakwa formation basalt (Quaternary) which generates the Korath range in the lower part of the western Omo, and consists of well preserved volcanic cones about 400 m above the plain.

The Sediment deposits of the lower Omo which result from both the solid transport of sediments by the river system and the geological deposits from Lake Turkana when its extent was much larger than it is today.

Seismicity

The Seismic assessment for the Gibe III project[3] was prepared by the Bureau of Geological and Mining Research (BRGM), a French public institution. The assessment was undertaken in accordance with International Commission on Large Dams (ICOLD) recommendations (1989).

The Gibe III dam site is located at about 70 km from the eastern branch of the East African rift system. It is a region of diffuse seismic activity that suffered severe earthquakes events throughout its history: August 25th 1906 (Ms=6.6 and 6.8), September 16th 1913 (Ms=6.2), July 14th 1960 (Ms=6.3) and October 25th 1987 (Ms=6.2 and Mw=6.2).

An earthquake centered in the vicinity of the Weyto horst (about 50 km south of the study area) occurred in 1973. Since the turn of the century, nine earthquakes with a magnitude greater than 4 have been recorded in the area. Three more have occurred in northern Kenya just south of the area, one to the north and three close to the northeast, the latter being associated with the Main Ethiopian Rift. Three of these have been recorded since 1950. Most were in the immediate proximity of the Chew Bahir rift and its northern extension. None have been recorded in the area West and Northwest of the Omo River, although tremors were felt at Mizan Teferi in 1971. This information suggests that presently the Chew Bahir rift system is seismically more active than the Turkana rift system.

Despite evidence that a certain seismic activity affected the region in historical times, according to the L1D Geological Report, no evidence seems to exist of present seismic activity in the project area.

The EFTA report considers that the previous seismic events referred to have only been recorded over a short recent period (approx 100 years) and it must not be excluded that the site is located in a seismic gap, i.e. an area where earthquakes do occur but with an interval between events such that none has occurred in the recorded past. The EFTA report considers that the available data has been interpreted in a rational manner in accordance with current industry practice, but that seismic hazard assessment requires extrapolation to future events which may not follow a known pattern.

No specific comments on the risk of reservoir induced seismicity are presented in the Gibe III technical documentation. Whilst RIS is a risk where the water impounded is more than 80m in depth, it is not possible to predict whether, where or when it will occur. However, minor events are usually recorded during impounding before a large event occurs. In accordance with ICOLD guidelines the EPC Contractor has confirmed that seismic monitoring will be installed within the dam although details are not yet available.

Reservoir Slope Stability

Along the river courses some areas characterized by high relief energy, i.e. by vertical or near-vertical walls up to tens of meters high have been detected. In most cases they probably correspond to massive volcanite flows or sills. These areas are relatable to the risk of potential rock falls; instability mechanisms such as toppling or collapse of wall portions might be produced by saturation of the rock mass consequent to the reservoir filling. The presence of hard, fractured rocks lying upon weak horizons such as ash levels, inter-bedded paleosoils or weathered volcanites, may potentially increase slope instability, as a consequence of the reservoir filling and saturation of the rock mass on the valley flanks, provided that appropriate topographic and fracturing conditions occur.

However, the preliminary analysis of the available geological mapping and photos performed during the design stage of the Project has not identified major instability problems on the reservoir slopes.

In the reservoir area, it is possible to meet two types of slope instability in relation to the principal lithological types: rock falls and toppling which occur in trachyte and rhyolite formations and landslides which occur in pyroclastic rocks (tuff, ash, agglomerate and volcanic sand).

Additional surveys in the reservoir area are already scheduled by the EPC Contractor.

Climate

Most of the information on climate presented in the ESIA comes from the Omo-Gibe River Basin Development Master Plan Study (1996, Richard Woodroofe & Associates, Mascott Ltd). The Plan provides a critical analysis of climatological data from monthly recordings of 64 meteorological stations. Most are located in the upper part of the river basin. There are currently no stations in the lower Omo region.

[3] Report 300 GEN R BR 001 A Seismic Hazard Assessment, February 2007

The climate is classifiable as tropical humid in the highlands that include the areas surrounding Jima to the north-west of Gibe III site and around the headwaters of the Gojeb river. For the rest and greater part of the watershed, the climate is classifiable as tropical sub-humid, intermediate between the tropical humid and the hot arid climate characteristic of the southernmost part of the plain towards Lake Turkana.

The seasonal variation in climate is associated with the oscillation of the Inter-Tropical Convergence Zone (ITCZ), a low pressure area of convergence. The ITCZ shifts during the year northwards across southern Ethiopia from September to November and southwards from March to May, giving origin to the alternation of a wet (from May to September) and a dry (from December to April) season. During the wet season the area is under the influence of Atlantic equatorial westerly and southerly winds from the Indian Ocean, producing strong precipitation, mainly due to the Atlantic moist component. During the dry season moist air comes from the Gulf of Aden and the Indian Ocean, causing little rains.

Temperature

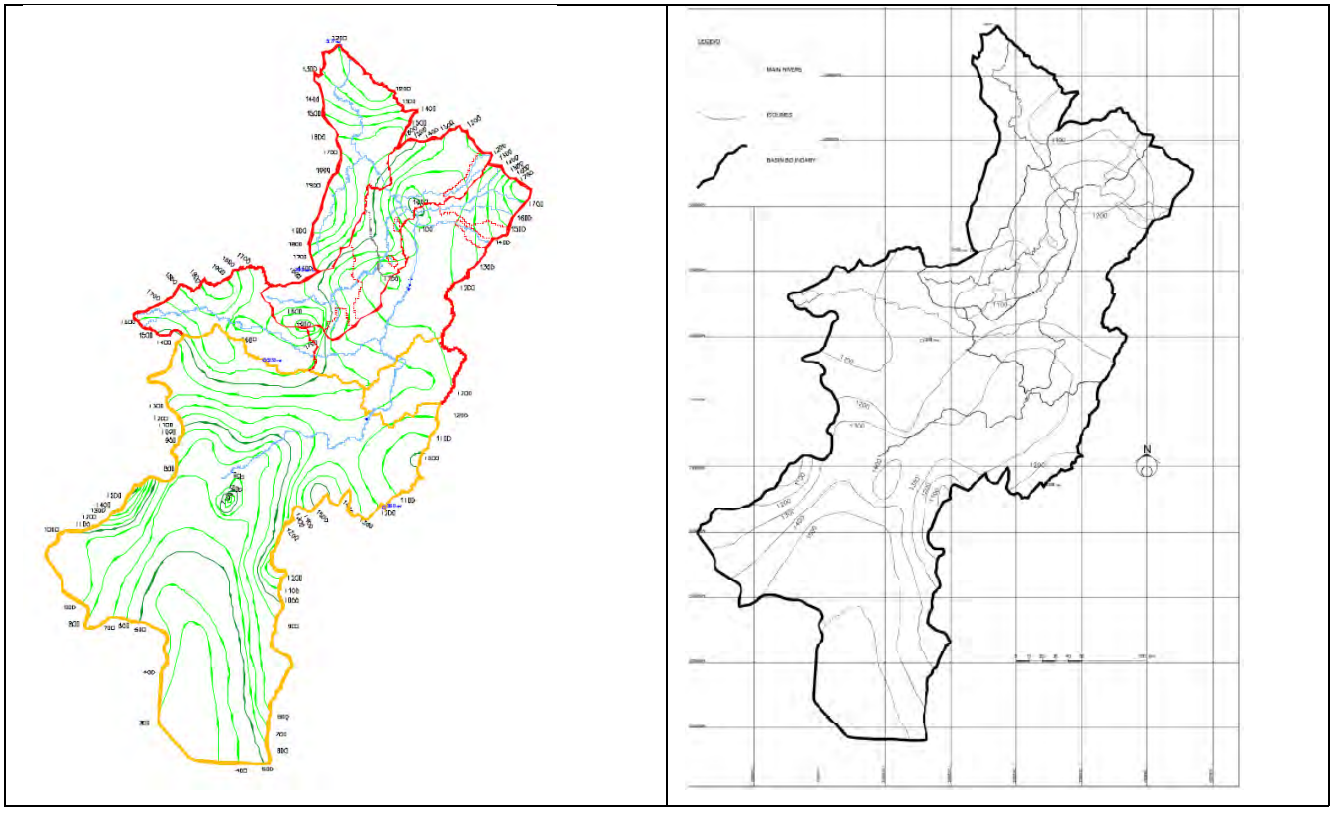
At the Gibe III dam site, the average annual air temperature is 20.4°C. Average maximum monthly temperature ranges from 26.8° C (February) to 21.5° C (July). Average minimum monthly temperature ranges from 14.5° C (March) to 12.6°C (July). Mean monthly temperature ranges from 20.6°C (March) to 17.1°C (July).

In the downstream plain, ie. in Omorate the average annual temperature is 29.8°C, the warmest month being August (30.8°C) and the lowest monthly average is 29.3°C (March, September, October). There is no present climatic station. Data is from a defunct Presbytarian Mission in Omorate reported in the 1989 Sogreah/FAO Soil Survey Studies.

Rainfall and Evaporation

The area of greatest rainfall is to the NW of Jima (outside the Gibe Basin). Rainfall declines sharply in the lower lying southern parts of the basin. According to the Omo-Gibe Basin rainfall distribution map presented below (source : Omo-Gibe River Basin Development Master Plan Study, 1996), the rainfall ranges from over 1,900 mm/year in the northern and western part of the basin, to about 1,200 mm/year in the lower part of the project area. Rainfall rates decrease strongly southwards, to less than 300 mm/year near Lake Turkana. The mean annual rainfall over the Basin as a whole is 1,140 mm. Evaporation follows an inverse pattern, being much higher in the downstream area than in the Project site and reservoir catchment.

Figure [4] - Rainfall & Evaporation Distribution Map of the Omo-Gibe Watershed



Source: Omo River Basin Development Master Plan

Table [6] - Mean Monthly Rainfall at Dam Site

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	27	40	84	112	152	211	248	243	164	81	33	24	1426
ETo (mm)	136	135	157	160	159	139	132	134	135	148	137	130	1702

Source: Gibe III ESIA, 2009

At dam site, annual precipitation is 1426 mm, with 248 mm in July (wettest) and 24 mm in December (driest month). In the upstream Project area (dam site and reservoir) about 70 per cent of the total amount of annual rainfall occurs between May and September.

Table [7] - Mean Monthly Rainfall at Omorate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	15	18	36	89	50	18	39	4	5	20	17	24	335
ETo (mm)	202	203	194	138	248	197	217	230	172	126	151	217	2293

Source: Sogreah/FAO Soil Survey Studies, 1989

Rainfall in Omorate is about 5 times lower than at the dam site, with only 335 mm/year in average. Evapotranspiration, with 2,293 mm/year, is 35% higher than what is measured at the dam site. Annual rainfall is also unreliable, resulting in frequent droughts. The situation is even worse further south in the Lake Turkana area where annual rainfall reported from Lodwar (Kenya) is only 220 mm/year, while evapotranspiration rises to 2,525 mm/year. Open surface evaporation in Lodwar reaches 3,057 mm/year, with a monthly maximum of 330 mm in May and a monthly minimum of 168 in October (FAO ClimWat).

The amount of rain received annually is thus insufficient to grow rainfed crops in the lower portion of the basin and people in that area depend strongly on the river flooding the land to provide enough soil moisture for subsistence recession cropping.

The rainfall pattern substantially varies within the watershed. In the northern part of the basin precipitations show a marked unimodal distribution with a pronounced peak in August and a long dry season from November to March. In the central part a trapezoidal distribution can be observed with a quite constant rainfall from May to September and a less pronounced dry season from December to February. In the southern part a marked bimodal pattern is visible with a higher peak in April and a secondary peak in October. The variation of the rainfall pattern in the watershed contributes to the natural regulation of the lower Omo River flows. The following graph (see Figure [5]) illustrates the average monthly rainfall at three typical meteorological stations during a 40 years period (1955-1994):

- Wolkite, in the north, elevation 1,700 m, rainfall 1,150 mm/year;
- Bonga in the centre, elevation 1,700 m, rainfall 1,700 mm/year;
- Jinka in the south, elevation 1,400 m, rainfall 1,200 mm/year.

Omo River Hydrology

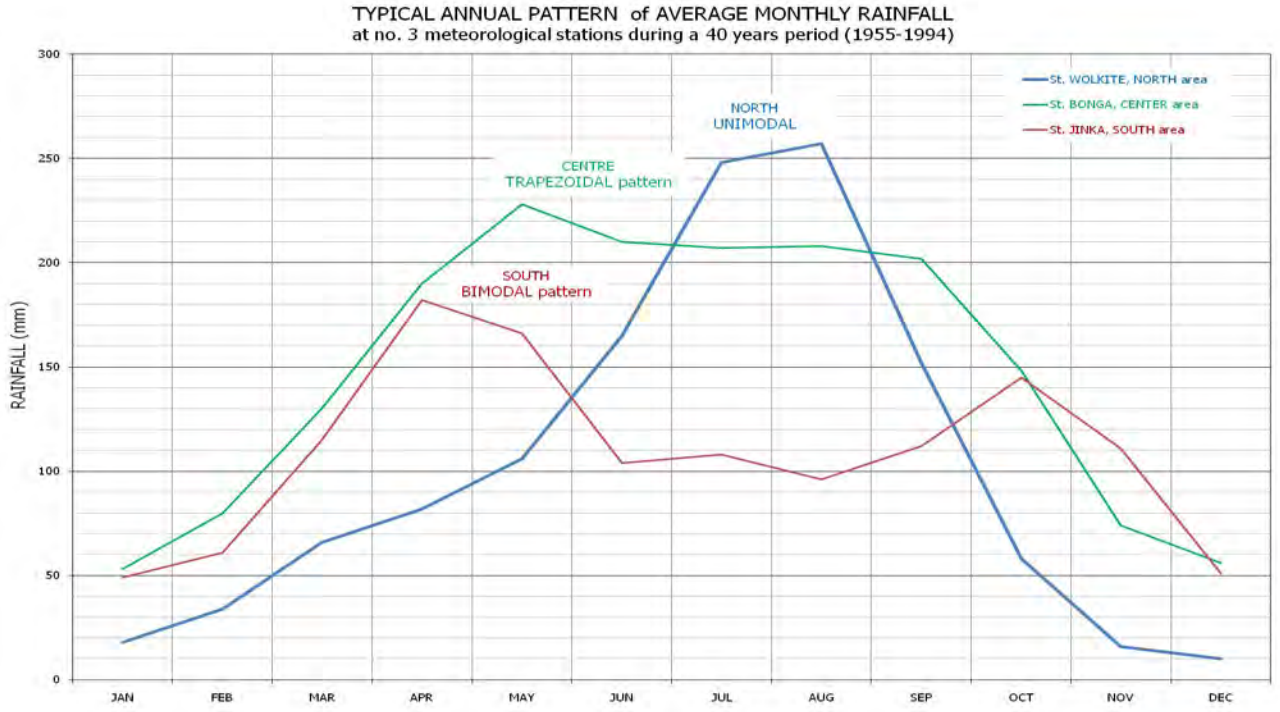
Omo River Morphological Profile

The ESIA-DS Section 3.1.1 "Geomorphology" provides a description of the Omo River typology downstream from the dam. Four types of river course have been identified:

- From km 0 (Gibe III dam site) to km 200, the river shows a rather steady longitudinal slope of 1.14 m/km. The river flows within steep basalt slopes and the flow speed is sufficient to prevent sediment deposition. There is no trace of permanent or temporary human activities in this area (no agriculture, no settlements).
- From km 200 to km 350, the longitudinal slope of the river is smoother, only 0.50 m/km. The river minor bed, of a trapezoidal section, is deeply incised into the plain alluvium, between about 10m vertical walls. Scattered flood-recession agriculture is observed in the few places where sediment is deposited, mainly the inner part of the meanders.
- From km 350 to km 660 (close to Omorate), the longitudinal slope is even smoother, with only 0.10 m/km. The river shows an extreme meandering pattern, with several ox-bow seasonal reservoirs resulting from river's dead meanders. Recession agriculture is extremely developed in this stretch of the river with development of deposits along the inner part of the meander but also along the river banks. The area is inhabited. Dipa Lake, near Kara Korocho is one of these oxbow lakes. It is seasonally flooded through small natural channels which cross the river bank. The main one is about 2 to 5m width and 1 to 2m deep.

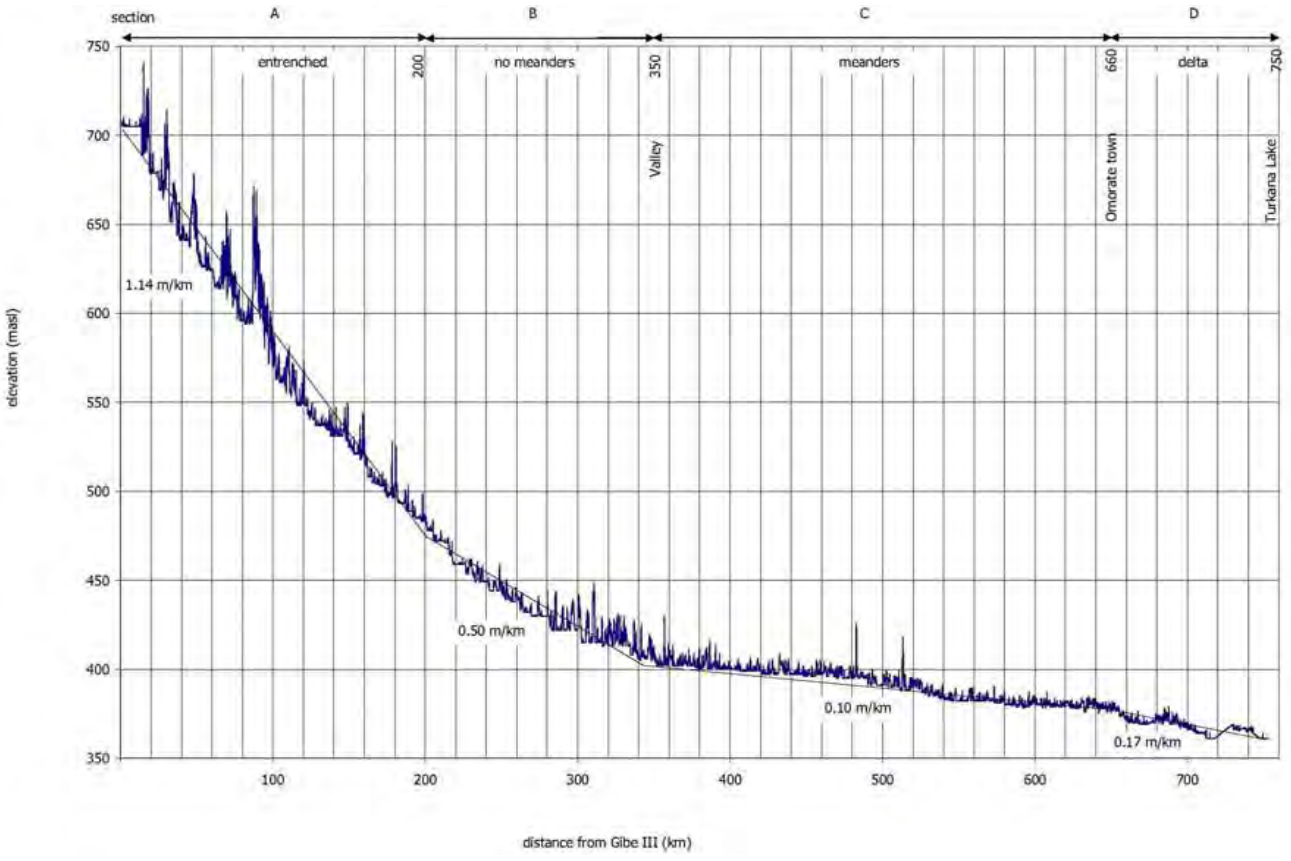
From km 660 to km 750, this last section has a longitudinal slope of 0.17 m/km and constitutes the Omo delta, where the river divides into several arms. The area is a patchwork of wetland, pastureland and recession agriculture along the main river branches.

Figure [5] - Rainfall Pattern Variation within the Omo-Gibe Watershed



This typology correctly reflects the situation the ESIR Consultant observed during an aerial survey performed in December 2009. The profile is illustrated in the following Figure [6].

Figure [6] - Profile of the Omo River between Gibe III Dam and Lake Turkana



The delta Area

The delta is a vast and flat area of sediment deposits. The river bed of the Omo is about 100 to 120m wide and about 10m deeper than the plain but this depth reduces when it moves towards Lake Turkana. The river banks support a riverine forest of tall trees, which means the river bed has good stability of its banks. The river bed probably deepened in its downstream part because of the drawdown of Lake Turkana level during the last century. This may explain a steeper slope than the upstream river section. The river banks are regularly crossed by secondary branches of the river which become active under flood conditions and which fill water in the depressions and wetlands of the delta.

Most of the active part of the Omo system is in the western part of the delta, where most agricultural activities (irrigation and recession agriculture) are concentrated. The eastern part of the delta consists of a floodplain flooded either by the Omo or by eastern temporary streams, with localized drainage problems resulting in soil salinization.This last area is not cultivated. It is grazed by livestock and some permanent water points for animals can be observed. At the south-eastern part of the delta there is a small brackish lake, Lake Ado which discharges in Lake Turkana.

Chainage km 0-200 typical morphology of the Omo River valley downstream Gibe III)

Typical profile of the Omo valley along chainage km 200-350

Typical profile of the Omo valley in the plain (chainage km 350-660). Intense meandering, recession agriculture, oxbow lakes inside meanders

The river in the delta area (chainage km 660-750)

View of Dipa Lake near Kara Korocho

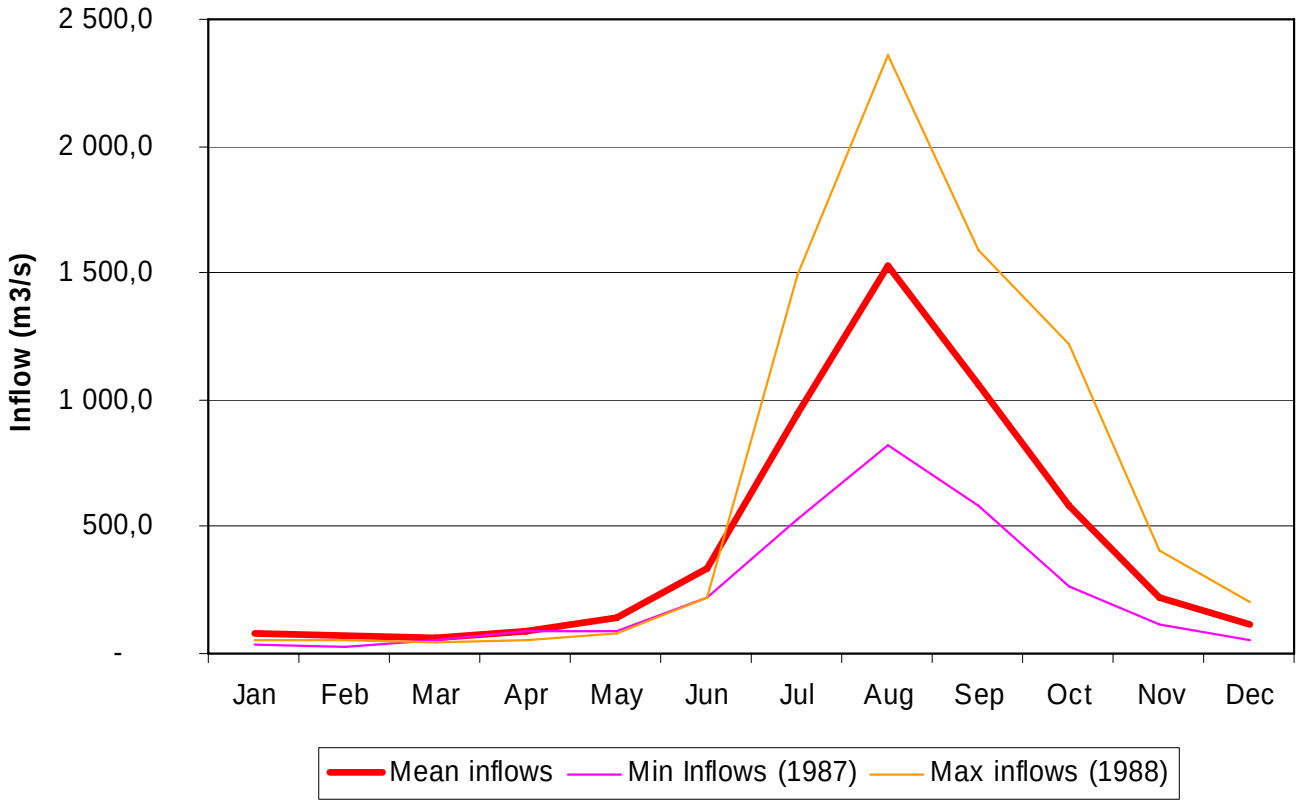
View of the main flood feeding channel to Dipa Lake

Omo River Flows and Floods

The Omo River Basin covers a total area of 73,500 km² at its confluence with Lake Turkana. Its elevation ranges from above 3,000 m in the north down to about 360 m, the average elevation of Lake Turkana. **The total catchment controlled by Gibe III is 34,150 km² or slightly less than half of the Omo catchment**.

Monthly inflows to Gibe III have been reconstituted over the period 1964-2001 and are provided in the ESIA. The following figure gives the mean monthly flows at Gibe III with the mean monthly minimum and maximum observed during the period. Mean monthly inflows vary from 61 m3/s in March to 1,529 m3/s in August. On the same period 1964-2001, the flood month flow (august) varies from 819 m3/s (1987, dry year) to 2,360 m3/s (1988, wet year).

Figure [7] - Monthly Average Flows at Gibe III



The assessment of inflows at the entrance of Lake Turkana poses more difficulties because the absence of any flow records of the complementary Omo catchment downstream Gibe III. Some assessments are presented in the Gibe III hydrological reports and included in the ESIA-DS. These are based on the characteristics of the downstream catchment, on the rainfall pattern, on runoff coefficients and on potential evapotranspiration.

The estimate of the inflows from the intermediary catchment is about 50% of the inflows at Gibe III. The reports do not provide information on the calculation details. **The average contribution from the Omo basin to Lake Turkana is estimated at 650 m3/s** in the ESIA-DS.

The Figure [8] below depicts the monthly average flow of the Omo River at its entrance in Lake Turkana. Because of the bimodal rainfall pattern in the southern region, the contribution from the intermediary catchment is the highest in May-June and September-October.

Considering the importance today to assess precisely the contributions of the downstream catchments for the development of mitigation measures in the downstream plain and for the water balance of Lake Turkana, it is urgent to check the validity of the assessment through the implementation of a river gauge station near Omorate (far enough from Lake Turkana for being unaffected by the fluctuations of the Lake levels).

Due to the size of the river basin, extreme floods may occur with detrimental impacts in the plain. The hydrological studies estimate the 10,000 years recurrence flood at 10,000 to 11,000 m3/s at Gibe III site level. The latest disastrous floods observed happened in August 2006, over a 5 days period after heavy rainfall all over the country. In the Lower Omo, 364 peoples and 900 livestock were killed while about 6,000 peoples were displaced. The rehabilitation program of the destroyed public facilities was estimated at 17 millions US$ (Relief Bulletin, 28 August 2006, UN Office for Coordination of Humanitarian Affairs).

Lake Turkana

Lake Turkana (previously named Lake Rudolf) is situated in Kenya, with the exception of its northern extremity and the Omo delta which are in Ethiopia. Lake Turkana has no outlet, and water is lost from the lake mainly by evaporation. The water level of this closed basin lake is determined by the balance between the influx from rivers and groundwater and the evaporation from the lake surface.

Lake Turkana is the largest evaporation lake of Africa with an area of 6,750 km². It drains a catchment area of 130,860 km² mainly situated in semi-arid to sub-desert areas. Its size is around 290 km long and 30 km wide in average. The lake capacity is estimated at 203.6 km³ (billion cu.m.). It is considered in the literature that the Omo River provides 80 to 90% of the lake's annual inflow, which explains the concern of the Gibe III project for the lake.

The lake is exposed to frequent strong winds, the prevailing wind direction being from the southeast. As a result of the high temperature year long and of the wind, the evaporation rate is high, around 2,300 to 2,500 mm/year.

The water level of the lake shows annual and inter-annual fluctuations, as the result of the balance between river inflows and evaporation. Between 1900 and 1994, the Lake's level receded 15.5 m (see Figure [9] below).

Between 1993 and January 2010, the monitoring by satellite shows total lake level amplitude of 5 m (see figure), ranging from +3 to -2m for a 9 years average value. After a stable period from 1993 to 1997, the level rose by 3 m from 1997 to 2000 and then decreased regularly between 2000 and 2007 to reach back its level of 1993. It raised again by 1.5 m these last two years. Globally, its level rose by 2 m since 1993 (see Figure [10]).

The inter-annual fluctuations of the water level results in strong implications regarding the delta area because of the smooth slope of the land. Below, two satellite images of 1973 and 2006 depict this situation (see Figure [11]), where the delta area in 2006 is 2.5 to 3 times larger than in 1973.

Water Quality & Sediments

Water Quality

Data provided in the ESIA (see Appendix [3]) refer to only one sampling campaign performed on 25 April 2006 in 3 sampling points along the Omo River: (1) at Gibe II power house (equivalent to the Gibe III reservoir tail), (2) at Bele bridge (upstream the Gibe III construction site) and at Gibe III dam site.

This data can hardly be interpreted, as there is no possible comparison with other months of the year, and no meteorological and river flow conditions are provided at the time of sampling.

In the Omo-Gibe River Basin Master Plan, some information on the Omo River water quality sampled near Omorate is provided. In the dry season the electrical conductivity is 1 dS/m, which is just above the medium salinity limits for irrigation water. During the wet season it is only 0.1 dS/m) which indicates very high quality water for irrigation. It is suspected that the water quality in the low season is influenced by Lake Turkana, which is only about 30 km downstream Omorate.

It is necessary to carry out a water quality survey for key parameters which covers a full year period with monthly sampling.

Available results from ESIA are provided in Appendix [3].

Figure [8] - Monthly Average Flows at Gibe III & Lake Turkana

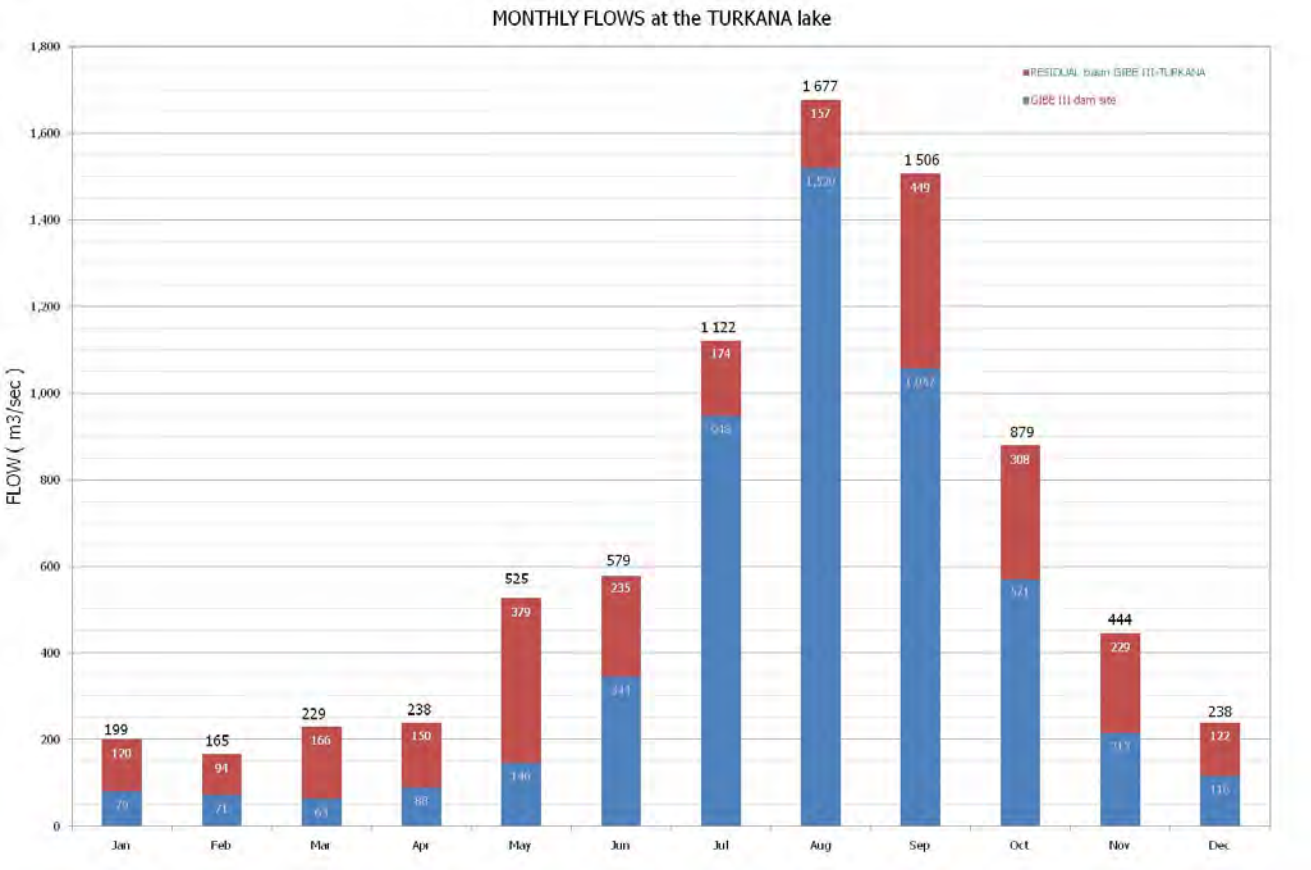
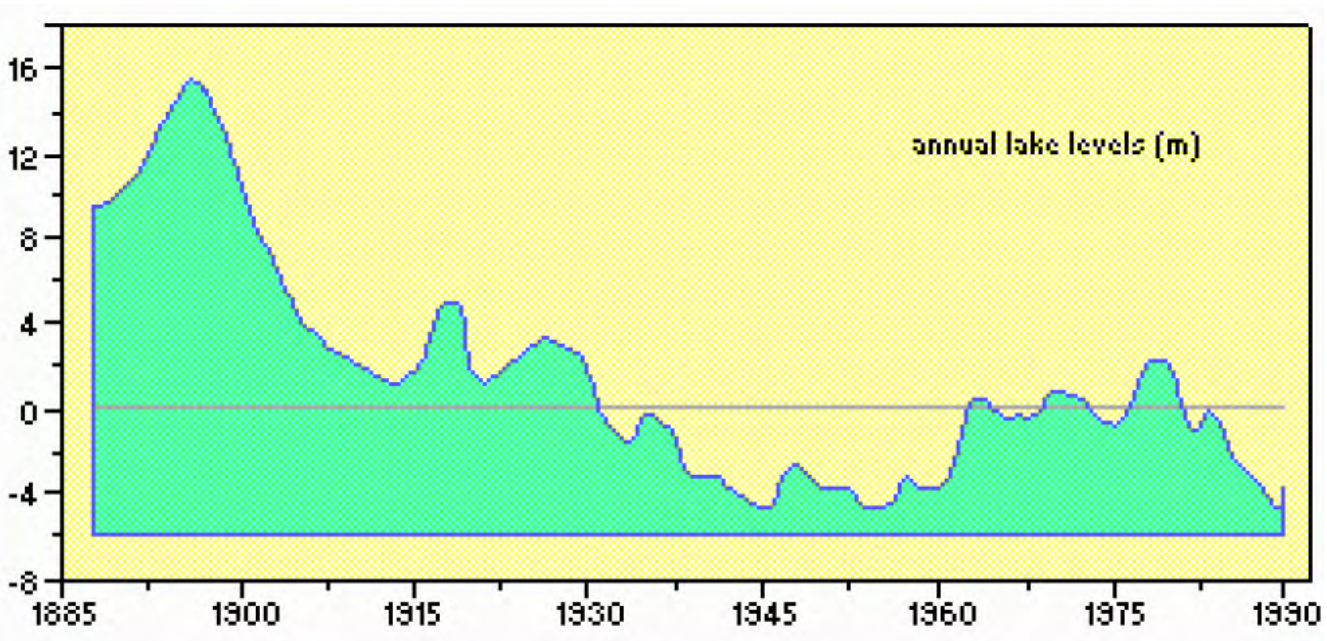
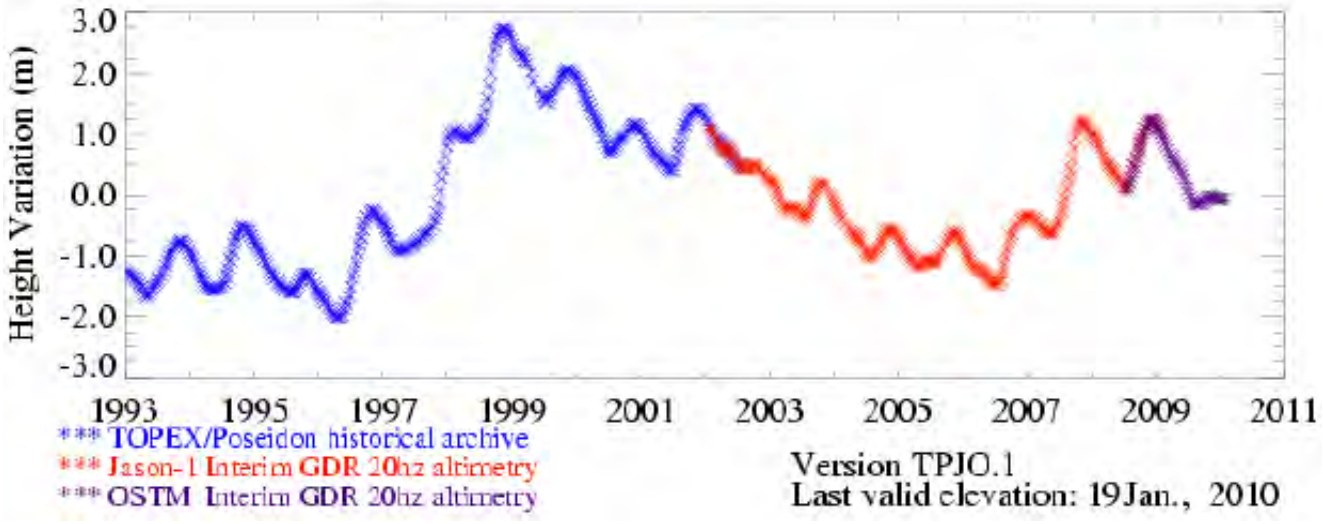


Figure [9] - Lake Turkana Level Fluctuation, 1900-1994



Source: ILEC, 2009

Figure [10] - Lake Turkana Height Variation during Period January 1993-January 2010



US Department of Agriculture, 2010

Figure [11] - Impact of Lake Turkana Level on Delta Area

Sediment Transport

The study done by SP is detailed in the sedimentation study report (April 2007). It leads to an average sediment inflow of about 18 Mm^3/year (varying between 17.5 and 18.3 Mm^3/year, depending on the calculation method used). Sediment trapping by Gibe I and Gibe II intake are taken into account assuming that (potentially all) the sediment is trapped into the reservoir.

According to the study, 98% of the mass of inflow sediment will be trapped in the future reservoir. This leads to an annual trap of 18 Mm^3/year, a low volume compared to the dead capacity of the reservoir which is 2500 Mm^3. This offers a duration life of the reservoir of more than 130 years.

Vegetation Biodiversity

Vegetation pattern changes observed in the Project area depend mainly on the climatic and the soil conditions observed as well as the human pressure imposed by the local communities. In accordance with previous reference works[4] on vegetation in Ethiopia, the following major vegetation types characterize the Gibe III Project Area:

- The riverine forests, distributed along the Omo River and major tributaries in the reservoir area (upland type) and in the plain area (lowland type), characterized by tall trees and dense canopy cover;
- The deciduous open woodland/bushy woodland, which covers the slopes of the future reservoir area;
- The lowland dense (thicket) and the lowland scrubland grassland, which characterize most of the Mago and Omo Park areas;
- The Somalia-Masai *Acacia-Commiphora* deciduous Bushland, which characterizes most of the lower plain (Turmi, Omorate areas);
- The lowland semi-desert bush and shrubland, the driest vegetation type observed in the project area.

The Upland Riverine Forest

The upland riverine forest is developed along the Omo River stretch located in the reservoir area down to an elevation of about 700m, below which it is progressively replaced by the lowland riverine type. Because of the vicinity of the alluvial aquifer, trees benefit from year-round water supply and develop faster and higher than in surrounding areas.

Most common and characteristic species include Albizzia gummifera, Syzygium guineense, Celtis Africana, Sterculia Africana, Lamnea schimperi, Terminalia brownie, Anogeissus leiocarpus and Ficus thonningii. Other smaller tree species include Grewia bicolor, Diospyros mespiliformis, Dichrostachys cinerea, Croton macrocarpa.

None of the 33 tree or shrub species identified during the ESIA survey is registered as rare, endangered or protected species.

The Lowland Riverine Forest

The lowland riverine forest stretches along the Omo River levees and its main tributaries such as the Mago and Neri Rivers.

These often become more structured, developed and diverse particularly in correspondence to the inner (inside) portion of meandering river bends, on depressions and towards the middle portion of the Omo River delta, as well as possibly in areas with less human disturbance and increased soil humidity availability.

This ecosystem gradually changes its vegetation composition along drier semi-perennial tributary rivers and seasonal streams, and in its external transitional zones (mostly along the eastern banks of the Omo River delta), hosting species more distinctive of the above-described xeric environments.

Characteristic trees include Celtis integrifolia, C. zenkeri, Haplocoelum foliosum, Lepisanthes senegalensis, Melanodiscus oblongus, Tamarindus indica, Terminalia brevipes, Trichilia emetica, Ziziphus pubescent, Ficus spp, Albizia spp, Baphia abyssinica, Mimusops kummel and Phoenix spp. Tree crown coverage may be as much as 90 to 100% with an average height of the upper storey reaching 20m in favorable locations.

The understorey has been found to comprise Argomuellera macrophylla, Diospyros abyssinica, Oncoba spinosa, Phyllanthus reticulatus, Strychnos sp and Trichocladus ellipticus, while lianas and twigs include Artarbotrys, Hippocratea, Salacia, Phytolacca, and Uvaria spp.

Herbaceous strata of riverine woodlands and pastures (including the delta) have been recorded to include the following grasses and herbs: *Eragrostis tenuifolia, Cynodon dactylon, Leptochloa rupestris, Brachiaria spp, Trifolium semipilosum* and *Oxalis cornuta*.

Apart from their importance for timber production, riverine woodlands are also important for Non-Timber Forestry Products (NTFPs); as an example, in the river delta *Uvaria leptocladon* roots are being used as a medicine while *Maerua* and *Moringa spp* are employed, once made into a paste and mixed with water, to flocculate suspended sediments of the river water before using it.

As riverine areas are also essential for traditional and cultural values, local Weredas are introducing by-laws to protect them and encourage sustainable use (excluding timber harvesting and hunting, which remain prohibited).

Riverine forest does not develop in areas too frequently submerged or submerged over too long periods. Most of the years, the riverine forest stretch is not flooded and the development of the trees relies mainly on the alluvial aquifer which is only few meters deep. Much larger areas do exist in the delta where soil submersion is of short duration and where extensive shallow aquifers can support forest vegetation.

The Deciduous Open Woodland/Bushy Woodland

This vegetation type covers the slopes of the Omo River along the future reservoir. The larger tree species observed include *Acacia abyssinica, A. seyal, A. polyacantha, Combretum molle, Pilostigma thonningii, Entada abyssinica*. Bushes and shrubs include *Stereospermum kunthianum, Woodfordia uniflora, Dichrostachys cinerea, Bridelia sceroneura, Ximenia sp., Euclea schimperi*. The vegetation seems denser in the bottom of the valley than on the upper part of the slope, probably due to higher human pressure from surrounding communities (firewood, burning for pastureland regeneration). The vegetation density is generally low, with not more than 25-50% of soil cover.

[4] FAO (1984), Vegetation and Natural Regions and their significance for Land-Use Planning. AG: DP/ETH/78/003, Technical Report 4.

Friis I. (1992), Forests and Forest Trees of Northeast Tropical Africa. Kew Bulletin Additional Series XV. HSMO, London

Riverine forest stretching along the Omo River in the Gibe III reservoir area (notice very limited width of the forest)

Detailed view

Riverine forest along Omo River downstream the reservoir area (km 0 to 200)

The riverine forest at the entrance in the plain (about 250 km downstream of the Gibe III dam)

Riverine forest in the meandering zone of the Omo, north of Kara Dus

Riverine forest almost totally cleared near Omorate

The Lowland Dense Thicket and the Lowland Scrub-land-Grassland

Located at around 400-600m elevation, the lowland dense thicket is dominated by *Acacia spp, Combretum aculeatum, Grewia bicolor* and shrubs and bushes such as *Grewia villosa, Acalypha fruticosa, Asparagus spp*. Particularly observed within the Mago National Park.

In the Omo National Park, this ecosystem is dominant immediately behind the thin riverine forest along the Omo River banks, and takes the local name of Euphorbia Thicket, including the following trees and shrubs: *Acacia polycantha, A. elatior, A. mellifera, Acalypha fruticosa, Balanites aegyptiaca,Maytenus senegalensis, Combretum molle, Ziziphus mucronata.* Grasses and herbs include: *Panicum maximum, Setaria spp, Ruellia spp, Commicarpus spp, Justitia spp, Euphorbia hirta* and *Acalypha racemosa.*

The lowland shrubland-grassland is also found in the elevation range of around 500m, either in the Mago National Park, Murle, the Mursiland, and beyond the Omo River, also termed "Open Woodlands" within the Omo National Park.

These shrubby grasslands have around 20% crown coverage with bush/shrub vegetation scattered or clumped within thickets of limited extension, whose main species include *Acacia mellifera, Combretum hereroense, Cordia gharaf, Boscia coriacea, Grewia tenax, Grewia bicolor, Grewia villosa, Ehretia coerulea, Adenium obesum*, with succulents such as *Sanseviera abyssinica* and *Euphorbia*.

Open bushlands of the above kinds often host large stretches of grasslands / rangelands with herbaceous specie such as *Hackelechloa sp, Heteropogon contortus, Eulalia sp, Setaria sp, Brachiaria sp, Chloris sp*, as well as *Panicum, Paspalidium, Andropogon, Dactyloctenium*, and *Hypertilia spp*. Grazing legumes include *Tephrosia, Rhyncosia, Glycinum, Indigofera, and Vigna spp.*

The above vegetation formations appear to be under strong environmental stress mainly due to fuelwood removal and overgrazing by domestic cattle. The crown coverage is still relatively dense at around 50%.

The Somalia-Masai Acacia-Commiphora Deciduous Bushland

This constitutes the climax vegetation over most of the lower Omo area, characterized by drought resistant trees and shrubs. It occurs between 500 and 1000m elevation, particularly between Jinka, Turmi, Dimeka and Omorate comprising, among the dominant small trees and bushes *Acacia senegal, Acacia mellifera, Acacia seyal, Acacia tortilis, Commiphora africana and other Commiphora spp*.

The underlying shrubs strata includes Boswellia neglecta, Boscia coriacea, Combretum aculeatum, Grewia bicolor, Balanites spp, Adenium obesum, with some characteristic succulents, such as Caralluma spp, Aloe spp, Sanseviera spp, Sarcostemma viminale and Kleinia spp also present. The ground cover also includes species of Acalypha, Barleria, and Aerva.

This ecosystem is in many places under environmental stress due to extraction of fuelwood, forest fires and clearance for rainfed agriculture, with subsequent decline in regeneration capacity.

Photoplate N° 1. Vegetation Types (2)

The riverine forest vegetation in the Omo delta area

Remnant patches of riverine forest along Omo River downstream Omorate

View of the lowland semi-desert vegetation type on the right bank of the Omo, downstream Omorate

Lowland Dense Thicket between Turmi and Omorate

Lowland Grassland and Shrubland

Somalia-Masai Acacia-Commiphora Shrubland

The Lowland Semi-Desert Bush and Shrubland

This vast ecosystem, greatly representative of consistent tracts of the lower Omo southern portion (300mm rainfall or below), presents a broad range of different features in terms of species composition, frequency and abundance, density (thicket or sparse formations), and/or physiognomic type (bush, scrub or mainly grasslands) according to local prevailing conditions in terms of soils and human disturbances (mainly grazing).

Most of the species are highly drought tolerant, with the presence of many succulents such as *Euphorbia* and *Aloe*. *Acacia mellifera and other Acacia spp* (*A. horrida, A. reficient* and *A. mellifera* within the Omo National Park) appear to be dominant, with *Grewia tenax, Cordia gharaf, Cadaba farinosa, Clerodendron myricoides, Boswellia spp* and *Commiphora spp* amongst the shrubs.

Large areas representative of this ecosystem are observed on the eastern side of the Omo River, south of Omorate.

Wildlife

Dam Site and Reservoir Area

In the area of the future dam and reservoir the absence of human presence has meant that the wildlife in the area has been preserved. Most of the area along the river banks and the hill slopes has not been populated because of the steep slopes and the presence of tsetse fly. Some very small areas are cleared to create agricultural land, and some other areas are disturbed by the collection of firewood and gathering of other forest products.

However, despite the absence of human presence and the consequent preservation of wildlife, the biodiversity in the future dam and reservoir area is not as rich as the downstream areas where there are significantly more people.

The principal wildlife species that are thought to be present in the area have been identified through interviews with the few people present in the area and from observations made during the environmental baseline wildlife survey.

Mammals

• Most probable presence: Anubis Baboon (*Papio anubis*); Black & white Colobus (*Colobus guereza*); Grevet Monkey (*Cercopithecus aethiops*); Common Bush Buck (*Tragelaphus scriptus*); Leopard (*Panthera pardus*); Spotted Hyaena (*Crocuta crocuta*); Warthog (*Phacochoerus aethiopicus*); Duiker (*Sylvicapra sp.*); Hare (*Lepus spp.*); Lesser kudu (*Tarage laphus imberbis*); Crocodile (*Crocodylus niloticus*); Greater Kudu (*Tragelaphus strepsiceros*); Serval Cat (*Felis serval*); Mongoose (*Herpestes sp.*); Porcupine (*Hystrix cristata*) and Common Jackal (*Canis aureus*).

• Possible presence: Lion (*Panthera leo*); Hippopotamus (*Hippopotamus amphibious*); Buffalo (*Syncerus caffer*);

Birds

Those reported to be common in the Omo River basin include the following: Pale Chanting Goshawk; Vulturine Guineafowl; D'Arnaud's Barbet; Red & Yellow Barbet; Red-winged Bush Lark; Pink-Breasted Lark; Three streaked Tchagra; Taita Fiscal; Pale Prinia; Smaller Black-bellied Sunbird; Donaldson Smith's Sparrow Weaver; Magpie Starling; Red napped Bush shirike; Bare - eyed Thrush; Boram Citicola; Grey-headed Silver bill; Black-ramped Waxbill; Quail Plover; Brown Babbler; Dusky Babbler; Violet wood hoopoe; Allen's Grallinule; Green-Blacked Heron; Egyptian plover; Pel's Fishing owl; Snowy-headed Robinchat; African crakes.

Birds that were observed during the ESIA wildlife survey include Hammer kop (*Scopus umbreta*); Hadada ibis (*Bostychia hegedash*); Black Kite (*Milvus migrans*); Pale chanting Goshawk (*Melierax canorous*); Helmeted Guinea fowl (*Numida meleagaris*); Black-bellied Bustard (*Eupodotis melanogaster*); Common Sandpiper (*Actitis hypoleucos*); Red-eyed dove (*Streptopelia Semitorquata);* Loughing Dove (*Streptopelia senegalensis*); Ring-necked Dove (*S.capicola*); Orange-bellied parrot (*Poicepholus rufiventris*); White-cheeked Touraco (*Touraco leucotis*); African Cuckoo (*Cuculus gularis*); Speckled Mouse Bird (*Colius striatus*);Malachite King Fisher (*Alcedo cristata*); Narina Trogon (*Apaloderma narina*); Little Bee-eater (*Merops pusiilus*); Red-billed wood Hoopoe (*Phoeniculus purpureus*); Vonder Decken's Hombill (*Tockus Deckeni*); Silvery- cheeked (*Bycanistes brevis*);

They also include Nubian wood pecker (*Campethera nubica*); Yellow wagtail (*Motacilla flava*); West African Thrush (*Turdus Pelios*); White-crowned Robin chat (*Cassypha albicapilla*); Spotted Palm Thrush (*Cichaladusa guttata*); Paradise Fly catcher (*Terpsiphone viridis*); Brown Babbler (*Turdoides piebejus*); Yellow-bellied sun bird (*Nectarinia venusta*); Beautiful Sunbird (*N.pulchella*); Tchagra (*sp.);* Grey–headed Bush Shirke (*Malaconotus blanchoti*); Greater Blue- eared starling (*Lamprotornis chalybaeus*), and Yellow–billed Oxpecker (*Buphagus africanus*).

Downstream Area

In the downstream area, the biodiversity is characterized by a general decline in wildlife population numbers. The decline is a result of hunting and of the increasing numbers of livestock competing for rangeland. The local tribes are dependent on hunting because traditionally they do not rely on their domestic animals for meat. The effects of this practice are aggravated by their semi-nomadic lifestyle and the widespread availability of firearms.

The principal wildlife species that are thought to be present in the area have been identified from review of scientific literature and interviews with personnel responsible for hunting control. Most of these species are mainly concentrated in the 4 protected areas of the Lower Omo (Omo and Mago National Parks, Tama Wildlife Reserve and Morule Controlled Hunting Area.

Elephant; buffalo; lion and giraffe are reported as the main mammal species in the lower Omo. Other species comprise topi; eland; greater and lesser kudu; Burchell's zebra; gerenuk; oryx; waterbuck; warthogs; dikdik; Grant's gazelle; hartebeest; bushbuck; reedbuck; common duiker; oribi; jackal; wild dog; large spotted genet; whitetailed mongoose; spotted hyaena; leopard and cheetah. Sightings of the following primates have been recorded: Olive baboon; Colobus monkey; de Brazza's monkey; blue monkey and Grivet monkey.

With respect to threatened and endangered species, it is thought that the following species listed as threatened or endangered by the IUCN could be present in the Omo and Mago National Parks (see next section): Grevy's zebra (*Equus grevyi)* [Endangered]; Black Rhinoceros (*Diceros bicornis*) [Critically Endangered] and the African Wild Ass (*Equus africanus*) [Critically Endangered].

The Black Rhinoceros is reported to be sighted in the area, but not every year. Herbivores, such as the zebra, hartebeest and large gazelles are moving south out of the area because of the decrease in savannah-like vegetation. Hippopotamus have not been sighted recently and might exhibit very limited population numbers.

Colobus Monkey in the alluvial forest north of Omorate

Olive baboon

Dikdik Gazelle

Gerenuk Gazelle

Vulturine Guinea Fowl (Acryllium vultirinium)

Ground Hornbill (Bucorvus leadbeaeteri)

Local key bird species include ostrich, civet, vulturine guineafowl, yellow-necked spurfowl, eastern chanting-goshawk, bustards, red-bellied parrot, white-bellied go-away-bird, red-throated bee-eater, abyssinian scimitarbill, hornbills, barbets, pygmy batis, three-streaket tchagra, taita fiscal, larks, boran cisticola, pale prinia, rufous chatterer, dusky babbler, starlings, robin-chat, sunbirds, weavers, black-rumped waxbill, steel-blue whydah, sombre nightjar, bush-shrike, grey wren-warbler, whitebreasted white-eye, bare-eyed thrush, grey flycatcher, parrot-billed sparrow, white-headed buffaloweaver, silverbill, canary.

Regarding reptiles, crocodiles are commonly seen along the banks of the river (two specimens were observed by the ESIR Team on the river bank at Kara Korocho).

Protected Areas

The principal mechanism used by Ethiopia to protect biodiversity, ecosystems and ecological processes has been through a network of wildlife conservation areas and priority forest areas. The total sum of the area of wildlife conservation and forest areas – 14% of the area of the country – is above the global average for protected area coverage.

The Ethiopian PA System contains several categories, including National Parks, Wildlife Reserves and Sanctuaries, which were primarily designed for the protection of wildlife resources, as well as Controlled Hunting Areas and Forest Priority Areas, for the utilization of wildlife and timber resources. The overall management effectiveness of most PAs is low, as many areas are not legally gazetted, receive inadequate funding, are understaffed and ill-equipped, hence providing low levels of biodiversity conservation (GEF, 2008).

The recently created Ethiopian Wildlife Conservation Authority (EWCA) manages 13 National Parks and Wildlife Sanctuaries and regulates and administers quota setting and licensing in Controlled Hunting Areas.

There are no protected areas in the area of the future dam and reservoir. However in the downstream area, approximately 600 kilometers south from the future dam and reservoir and north of the border with Sudan, there are four protected areas: the Omo and Mago National Parks, the Tama Wildlife Reserve and the Murule Controlled Hunting Area (see Figure [12]).

The Omo National Park is managed by EWCA, Mago National Park and Tama Wildlife Reserve are managed by the Regional Authorities, and the Murule Controlled Hunting Reserve is managed by a private Group, under the control of the Regional Authorities.

Omo National Park

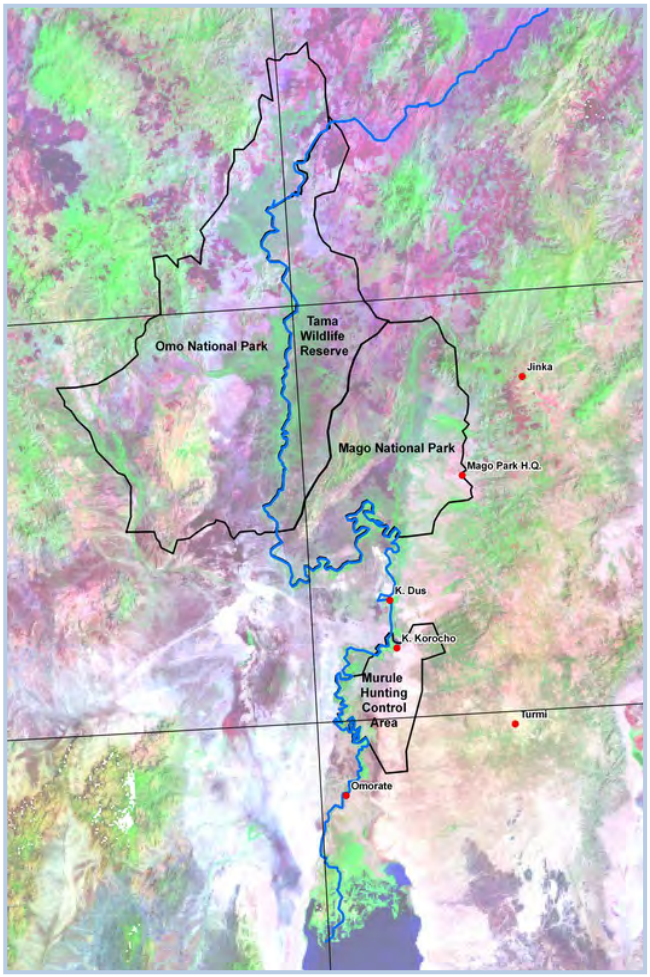
The Omo National Park covers an area of 3,848 km² and extends 140 km in a north-south direction along the west bank of the Omo River. The topography within the park is varied and includes areas of mountains, hills and plains. The vegetation is also varied, including areas of dense deciduous vegetation, sparse bushlands, thickets, shrublands and riverine forest.

The river banks are populated on a permanent basis by the Surma, Kwegu, and Dizi people. The Bume / Dasanech people are found in the southernmost areas and the Mursi people enter the park from their lands in the Mago National Park during the dry season.

There is a large amount of flood recession agriculture along the river from October onwards, with some limited areas being used for pasture for livestock grazing up to March. However most of the livestock graze on the *Euphorbia* thickets which characterize the vegetation in the interior of the Park.

The park has been significantly impacted by the presence of the local people, in particular with reduced numbers of wildlife from illegal hunting and reduced habitat from land clearing for agriculture.

Figure [12] - Protected Areas of the Lower Omo



Mago National Park

The Mago National Park is located to the east of the Omo National Park and covers an area of 2,162 km2. The elevation ranges from 400 masl on the plains in the south, to 1,776m on top of Mt Mago. The interior section of the park mainly consists of flat plains.

The park is traversed by the permanently flowing Mago River and two of its tributaries, the Neri and Usno Rivers. The national park is bordered by three conservation areas: Tama Wildlife Reserve to the west (currently inhabited by the Mursi people), Omo National Park to the southwest and Murle Controlled Hunting Area (MCHA) to the south.

Mago National Park is surrounded by settled agriculturists and semi-pastoralists belonging to six tribal groups: The south-east part of the park is populated by the Hamer people, who practice flood recession agriculture, shifting cultivation on higher escarpments, and the grazing of flocks of goats and cattle on the highlands and greener areas around the rivers. The north-eastern part of the park along the Omo River is populated by the Benna, Karo, Muguji and Kwegu people and in the south, the Mursi people practicing pastoralism and flood recession cultivation along the Omo River.

The wildlife in the park is reported to include populations of elephant, buffalo, tiang, baboon, lesser kudu and gerenuk. However, as in the Omo National Park, illegal hunting and poaching is impacting the wildlife population numbers.

Over the last 20 years, elephant population sizes and ranges have shrunk greatly both within and around the Mago National Park (MNP) mainly due to high hunting pressure. Estimates carried out in 1999[5] established the population between 387 and 575 heads. The survey estimated that 26 elephants were killed over 8 months by poachers, mainly for ivory.

Tama Wildlife Reserve

The Tama Wildlife Reserve covers an area of 3,269 km² and is located between the Omo and Mago National Parks. The natural vegetation in the reserve comprises mainly Acacia-Commiphora woodland and Combretum-Terminalia savannah. The main wildlife species include Giraffe, Burchell's Zebra, and Lelwel Hartebeest. The Reserve has no EWCO personnel and no infrastructure in place, and is managed by the Regional Tourism and Park Agency from the Southern Nations Capital city of Awassa.

Murule Controlled Hunting Area

Hunting has been the most important revenue earner in the wildlife sector and still is for the EWCA, although the majority of hunting revenue accrues to the regions (85%). Trophy hunters are willing to pay high fees (up to 14,000 US$ for hunting the Mountain Nyala[6]) and this source of revenue will continue to accrue.

The Murule Controlled Hunting Area covers an area of 4,172 km² (including 543 km² under concession) and is located south of the Mago National Park and east of the Omo River. The natural vegetation comprises semi-desert scrubland and *Combretum-Terminalia* woodland

It is one of the functional CHA owned by the Ethiopian Rift Valley Safari on a two year concession basis. Murule CHA has one lodge, which is located on the banks of Omo River. Wild animals common in Murule CHA includes lesser kudu, Gerenuk, Guenther's dikdik, greater kudu, tiang, bushbuck, warthog, defassa waterbuck, crocodile, serval, bush duiker, golden jackal, silver backed jackal, spotted hyena, klipspringer, anubis baboon, colobus monkey. The initial movement of wildlife between Mago NP and Murule CHA is presently strongly hampered by the intrusion of the Hamer livestock grazing the corridor between the two areas.

[5] Bekele Y. Bekele A., 2000. Population estimates and threats to elephants in the Mago National Park, Ethiopia. Tropical Zoology 13: 227-237, 2000

[6] *Tragelaphus buxtoni*, a large bovidae, endemic to Ethiopia and classified as endangered by IUCN

Constraints on Protected Areas Activities

The two National Parks face since several years difficulties to establish their activities. The first reason is the conflict with the local indigenous communities which owned traditionally the land. Without proper consultation and compensation at the time of the Parks creation, the communities re-established progressively within the Parks boundaries, with resulting competition between livestock and wildlife for the range, hunting (more prejudicial today because of the automatic weapons available) and poaching.

The development of the park activities are also hampered by (i) the absence of sufficient accommodation for the visitors (ii) the difficult access by road, almost impossible during the rainy season and (iii) a rate of observation reported as very low by the visitors linked to the dense shrub vegetation and most probably by a limited (and shrinking) population of big games.

Aquatic Biodiversity

There is no information available regarding plankton, algae species and benthic fauna of the Omo River. The density of suspended sediment, which gives the river its permanent brown colour, is a limiting factor to their development.

Around 70 species of fish are reported in the literature from the Lower Omo. Fishermen interviewed during the field visits mention 17 species which have economic and nutritional value.

The main species in terms of frequency of catch are reported to be:

- Three Cichlidae: *Tilapia zillii, Sarotherodon galilaeus*, and *Oreochromis niloticus*. Specimens of more than one kg are commonly caught, both in the Omo River and in Lake Turkana.
- Distichodontidae: *Distichodus niloticus*: various specimens of 2-3 kg seem common in the catch.
- Clariidae: *Clarias gariepinus*: specimens of 5-6 kg are commonly caught, but seem of little interest in terms of food. Small specimens – half to one kg on average – are caught with spears in the oxbow lakes when the water is at its minimum.
- Centropomidae: the Nile perch (*Lates niloticus*) is commonly mentioned by the fishermen but big sizes of 50-60 kg seem rare nowadays in Lake Turkana; the species migrates upstream in the Omo River where fishermen catch sometimes specimens of a few kg. They do not have access to the required equipment (big mesh size of 10 -15 cm knot to knot), as that frequently used in Lake Turkana (Nile perches of 12-15 kg were observed during the visit to Lake Turkana fisher's camps).
- Characidae: *Hydrocynus forskalii* (tiger fish) is also mentioned but is apparently scarce.
- Cyprinidae: Barbs species (*Barbus, Labeo*) are relatively common; according to fishermen they hardly reach one kilo.

Soils in the downstream Plain

Very little information concerning the soils, their potential and available cultivable lands could be obtained from the ESIA. However reconnaissance and semi-detailed soils surveys (areas south of Kangatin) were undertaken in the region (Omo Gibe River Basin Integrated Master Plan Study, 1996). These surveys may provide a basis for the localization and the implementation of the small scale irrigation projects (SSIP) which are proposed in the ESIA-DS to offset the negative impacts of the reduction (or the elimination) of the Omo River's seasonal floods.

The area bordering on the Omo River is relatively flat but the land begins to rise gently at a distance of less than 10km from the river. The river meanders within this floodplain and there are many oxbow loops and old channels. The water level in the river is between 10 and 20m below the surrounding plain depending on location, but in the flood season the water level often rises to flood the plains. The ridges bounding the eastern floodplain are dissected by drainage channels or temporary streams (wadis) which can carry high flows after a rainfall event. These flows cause the formation of gravel fans spreading across the flood plain towards the Omo River.

This area formed the bed of Lake Turkana in geological time but in recent centuries the lake level has fallen. The soils are a mixture of stratified alluvium and colluviums and are not fully developed; there are extensive areas of sodic and saline soils and hard pans. There are also some heavy clay with vertic properties particularly in drainage areas. Due to the nature of formation of these soils they are very variable both laterally and vertically with good soils found in patches amid poor soils. Similarly, even in areas of good soils there are likely to be some areas unsuitable for irrigation.

As a result of the soil surveys, lands suitable for irrigation were divided into three classes, according to the FAO "Framework for Land Evaluation". None of the soils in the lower plain have been classified as Class 1 - highly suitable for irrigation.

Most of the soils have been entered into Class 2 - moderately suitable, or Class 3 - marginally suitable. Results are given in the table below.

Land evaluation indicated that whilst there is no land presently highly suitable, **there are some 30,600 ha of moderately suitable and 33,300 ha marginally suitable land.** 21,400 ha are now unsuitable. With remedial measures such as surface and subsoil drainage, crevasse infilling and leaching with gypsum, provided these are economically viable, then some 5,000 ha would become highly, 60,000 ha moderately and 14,000 ha marginally suitable.

Table [8] - Land Suitability for Irrigated Agriculture

Suitability Class	Current Suitability		Potential Suitability	
	Ha	Percentage	Ha	Percentage
S1	-		5,252	5%
S2	30,629	31%	60,024	60%
S3	33,290	33%	13,729	14%
N1	21,362	21%	6,276	6%
N2	14,435	14%	14,435	14%
Total	99,716		99,716	

Source : Semi-detailed soil surveys – Lower Omo – 1996

Appendix [5] presents the main results of the previous surveys in terms of soil classification and land suitability for irrigation evaluation.

As indicated above, the alluvial sediments of the South Omo lowlands are extremely young and geomorphic processes have not been operating for a long time. Geomorphologically the area comprises the present Omo flood plain and delta into which the river is incised. The present floodplain / meander belt is seasonally flooded, comprised of recent alluvium, narrow levees, oxbows and back-swamps. Behind the levees the old Omo alluvial plain is composed of alluvium overlying lacustrine deposits with a channel-basin topography including serious crevassing and sink holes. Flatter lower-lying areas are composed of vertic clays over lacustrine deposits and are collecting sites for runoff. On the east bank this old flood plain abuts active alluvial fans and an old beach ridge of Lake Turkana.

On the west bank, the old Omo floodplain is littered with many old channels, often waterlogged and is now cutting back into older sediments which in turn are being eroded presumably as the current Omo level drops.

Soil chemical processes are also poorly developed though sodicity, and to a lesser extent salinity, are widespread although not always with the attendant structural degradation of sodium presumably because there has been little structural development. The development of hard pan is however evident in places. Sodium levels are acceptable for much of the area but very high in some places which are therefore to be excluded from any irrigation development. However, acceptable levels are likely to rise to unacceptable levels under irrigation especially on heavier soils.

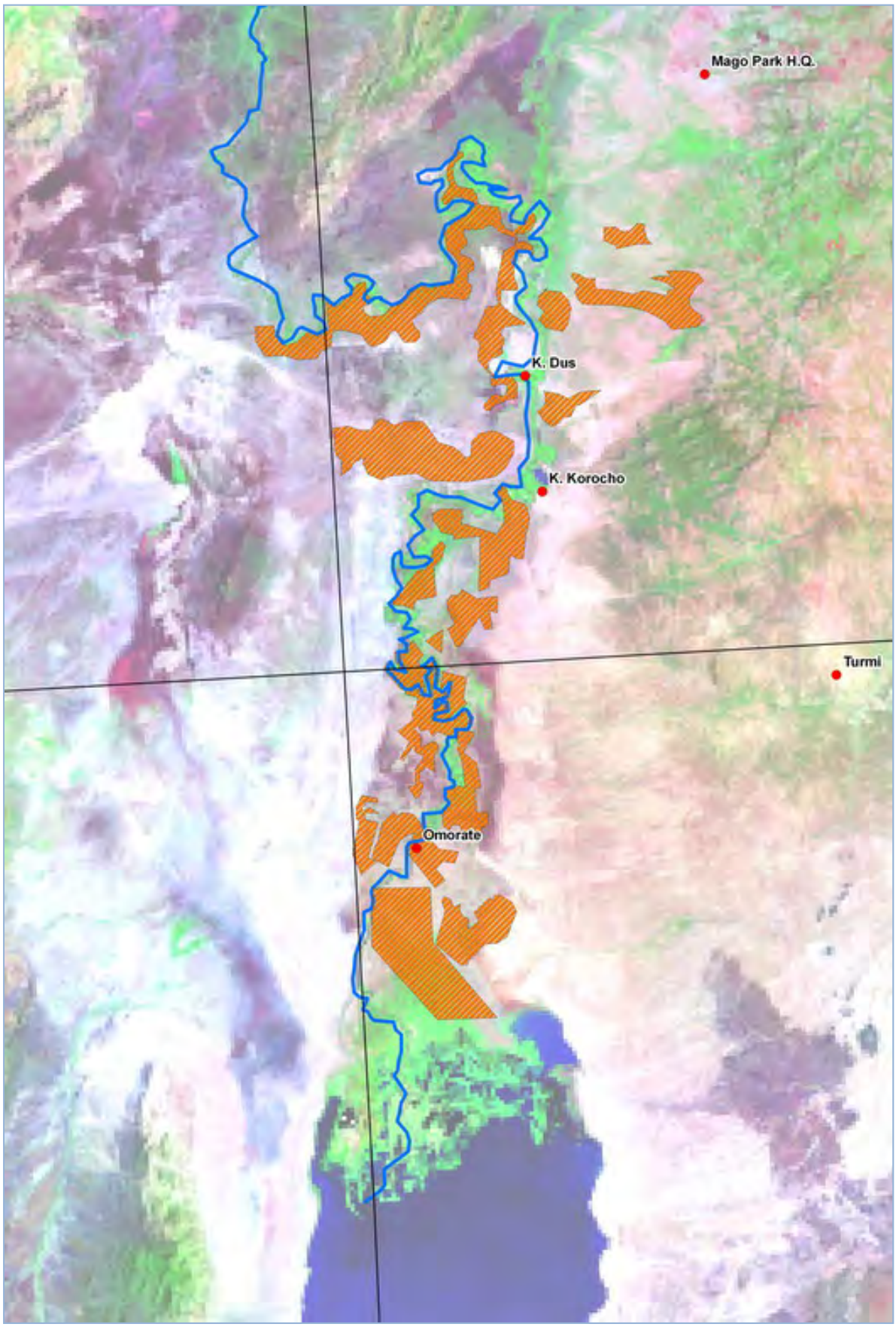
Most soils of the study area have pH levels higher than the preferred range for most crops. This is likely to cause deficiencies in Phosphorus, Boron and other micronutrients. The soils are therefore incipiently fertile, salinity, sodicity and high pH levels notwithstanding. Occasional high salinity levels occur in non-saline areas and **a thorough salinity survey should be undertaken before any decisions on development are taken**.

Most alluvial soils have high levels of available phosphorus. Sodic soils generally have lower levels and soils developed on alluvial fans and sandy soils have low mean levels. In summary, most available levels of phosphorus are moderate to high and **P-fertilizers would not be needed at least initially**.

An unusual feature of the area is the cracking or crevassing soils. Cracks occur in these soils under natural rainfall or when irrigation commences. These cracks may be several hundred meters long, up to two meters wide and five meters deep. This is partly because these soils have emerged from Lake Turkana in recent centuries and are not yet fully developed. When water is poured on to the soil it seeps into any cavities which exist and passes downwards rapidly, causing erosion. This is thought to be the reason for the sink holes that appear as noted when the Ethio-Korean Farm was implemented.

The phenomenon occurs naturally under heavy rainfall. However the situation is made worse when large quantities of irrigation water are applied to the soil. These cracks and sinkholes apparently fill up rapidly as there is little evidence of them on the ground; the cracks appear to fill within one year of formation. Some sinkholes may be seen and there are lines of vegetation that appear to follow recent cracks, but the cracks can appear without warning when it rains or during irrigation.

Figure [13] – Potential areas for irrigation



4.3 Social Baseline

Administrative Overview

Reservoir, Road and Permanent Camp Area

The part of the project affected by the future reservoir, road realignment and Employers Permanent Camp is well defined and covers five zones, 11 woredas and 67 kebeles. However, the main impacts involving resettlement and livelihood improvement activities are confined to the three woredas of Kindo Didaye, Kindo Koysha and Loma. The affected kebeles are well identified and number of affected persons and households listed[7].

Table [9] - Woredas and kebeles affected by Gibe III Resettlement

Zone	Woreda	Kebele
Wolayta	Kindo Koysha	Cherecha
		Menera
		Molticho
		Fujuna Mata
		Hanaze
	Kindo Didaye	Zaro
		Gocho
		Mogisa
		Patata
		Waruma
Dawro	Loma	Adisu Boderi
		Afuki Sori
		Dodi Anegela
		Gumer kocho
		Suba Tulema
		Lala Anebe
		Yello Werbeti
		Zima Waruma

Source: RAP, Table 5.1.

Downstream Area

The downstream impact area has been identified as consisting of four woredas in South Omo Zone: Selamago, Nyangatom, Hamer and Dasenech[8]. However, further three woredas are located adjacent to Omo River, i.e. Maji and Meinit Shasha Woredas in Bench Maji Zone and Decha Woreda in Keffa Zone further upstream[9]. The justification for not including these woredas appears to be that the riverine part of these woredas is entirely located within the Omo National Park.

The history of Omo National Park shows that there are people living within the park boundaries[10], although this might not show in official statistics. The ESIA-DS indicates that there are 1,300 people in Maji Woreda alone, who are dependent on recession agriculture[11].

It is therefore the ESIR Consultants opinion that an assessment should be made on to which extent people in the riverine zone in these three woredas will face potential impacts from the Gibe III Project.

Socio-economic Surveys

Reservoir, Road and Permanent Camp Area

Regarding the socio-economic survey, insufficient information is provided on how the 10% of all households were selected (i.e. randomly, stratified, etc.). To ensure representative data, a sample of 15% is usually required. Nevertheless, the data obtained gives a probable picture of the living conditions of the three woredas. Inclusion of value of production used for home consumption would have given a better description of the relative importance of various sources of livelihood.

Downstream Area

Two types of socio-economic data have been collected in the downstream area: primary and secondary.

Various secondary data has been collected from woreda offices to present a general picture for the project area, e.g. land use, livestock, health and education. It is found that 18,138 households depend exclusively on recession agriculture (along rivers or in the delta) in the five woredas of Maji, Selamago, Hamer, Nyangatom and Dasenech[12]. This figure is likely to include recession agriculture along other rivers (as has been observed in Hamer and Nyangatom Woredas by the ESIR Consultant). However, it is obvious from observation in the livestock dominated area that households in general do not depend exclusively on recession agriculture – it is an important supplement to livestock herding. Only for Karo people where livestock is less significant might recession agriculture constitute the main source of livelihood.

Primary data has been collected in the downstream area through a sample survey. The survey issues and sample methodology are not presented and unfortunately, an English version of the questionnaire is not presented. One issue covered is income and expenditure. However, to obtain an understanding of the scale and relative importance of various livelihood activities it is not sufficient to look only at cash income.

[7] RAP, Chapter 5.

[8] ESIA-DS, p. 74.

[9] Ibid, Figure 1.1.

[10] See e.g. http://www.conservationrefugees.org/threatened.html

[11] ESIA-DS,Figure 4.18. It is likely that this figure includes recession agriculture along other rivers as well.

[12] Ibid.

The ESIA-DS has somehow realized the problem, when it says: "*The majority of households in the South Omo Zone are primarily subsistence farming families with low cash incomes*[13]".

The data presented therefore reflect only a small part of the household economy. A better reflection of the actual situation would have been to also include sources of production used for the household's own consumption plus what has been sold informally (barter) – including products from hunting and collection. The constraint typically faced in such questions is to convert the value of produce consumed to monetary terms. However, a future survey team should be able to obtain prices for all products either at the local market or ask the respondent what price was obtained last time an item had been sold. Although such prices vary throughout the year and prices given might not be accurate, the final product of the survey will much better present the composition of the household livelihood than when only focusing on cash income.

It is recommended to carry out a representatively sampled socio-economic survey covering village and household levels. Even though all each ethnic groups in the area share some common livelihood practices, there are also differences; hence, the survey will sample among the ethnic groups represented in the impact area. The following sample structure reflecting the current ethno-demographic structure is suggested:

- Bodi (Selemago Woreda): 1-2 kebeles
- Mursi (Selemago Woreda): 1-2 kebeles
- Muguji (Selemago and Nyangatom Woredas): 1-2 kebeles
- Nyangatom (Nyangatom Woreda): 4 kebeles
- Murile (Nyangatom Woreda): 1 kebele
- Karo (Hamer Woreda): 1-2 kebeles
- Dasenech (Dasenech Woreda): 8 kebeles

In each kebele, interviews will be carried out with key informants (ideally semi-structured interviews with e.g. kebele chairman, elders, women representative, school teacher) on issues related to general trends of the kebele (i.e. socio-economics, ethnic specific traditions, history, health and education, government and NGO support).

In addition, household interviews using questionnaires will be made with at least 10% of the households – randomly selected – in the selected kebeles (minimum 15 households). If feasible, male and female heads of households should be present at the household interviews.

Population

Reservoir, Road and Permanent Camp Area

The December 2009 version of the RAP has been updated based on revised alignment of the Chida-Sodo Road as well as the Employers Permanent Camp.

Detailed demographic data is presented at kebele and woreda level covering population, sex and age distribution, education level, marital status, disabilities, recent deaths and potential vulnerability. Furthermore, data is presented on land holdings, relative importance of sources of cash income, and expenditures.

The data is based on a complete census and asset registration of the 892 households affected by the reservoir, road realignment and camp. A more detailed socio-economic survey was carried out covering "about 10% of the total households directly affected by the project"[14].

Census and asset registration has apparently been carried out thoroughly[15].

Downstream Area

The ESIA-DS presents through the sections 3.3.4 (Income and employment), 3.3.5 (Agriculture) and 3.3.6 (Livestock and grazing resources) aggregate data for the four affected woredas based on a field survey, although some of the data seem to originate from 2005. Some inconsistencies require more careful thought :

- Table 3.19 gives the agricultural and livestock production for the whole Omo River Basin.
- Table 3.20 presents a number of households depending of various farming systems (73,824 in total) incoherent with the number of households given in Tables 3.15 (28,713 in total) and 3.39 (33,396 in total).
- Table 3.27 gives a household size from 6 to 12 persons whereas Table 3.15 gives only 4 to 5 persons.
- Tables 3.15 and 3.39 present different figures for the population.

The different figures can to some extent be explained by different survey years; the data in Table 3.15 is from 2005 while no year for the data in Table 3.39 is given. However, the data from 2007 obtained by the ESIR Consultant is not very different from the population data in Table 3.39. Nevertheless, it is unlikely that the population has grown by more than 30% in average for the region in this period (8% in Nyangatom and 70% in Selemago). Change of administrative boundaries for the woredas could be a contributory explanation.

Some recent data at kebele level is in general available at the woreda agriculture and/or health offices. The ESIR Consultant obtained population data at these offices for the kebeles as well as information on which kebeles were located in areas where their inhabitants could practise recession agriculture along and utilize grazing land flooded by the Omo River.

[13] ESIA-DS, p. 88.

[14] RAP, December 2009, p. 17.

[15] The Census, Socio-economic (Household) and *kebele* questionnaire forms (RAP, Annex 4) are presented in Amharic only; these could have been presented in a bilingual version to facilitate an assessment of the questions asked.

Table [10] - Inconsistencies of population data in ESIA

Woreda	Table 3.15 (2005)	Table 3.39	ESIR (2007 census, figures from woreda administrations)
Hamer	43,505	61,909	61,349
Dasenech	46,479	52,665	57,340
Nyangatom	22,117	23,824	28,695
Selamago	19,332	32,900	28,888
Total	131,433	171,298	176,272

This data originates from the 2007 Population and Housing Census exercise (this detailed data at kebele level does not appear in the Summary and Statistical Report of the 2007 Population and Housing Census).

The detailed data for each kebele is presented in Appendix [6], while a summary is presented in Table [11]. The detailed baseline data shows that an estimated maximum of 67,644 people practice recession agriculture along Omo River. It is a maximum figure because the data is based on people living along Omo River rather than being based on people actually practising recession agriculture. This figure is considerably lower than the rough estimate made in the ESIA-DS, i.e. 100,000 people in the delta alone (p. 154). Demographic data obtained do normally not include household numbers.

According to informants in Dasenech, such numbers are received from the statistical bureau in Addis Ababa and are not based on the actual situation.

In addition, it is estimated that up to 16,524 people make use of grazing land usually flooded by same river (in Dasenech Woreda). Hence, an estimated maximum of 48% of the population in the four woredas will be affected by the Project. In addition, there might be villagers located within the boundaries of the Omo National Park, as mentioned above.

Table [11] - Population practicing recession agriculture along, and pasture land flooded by, Omo River, 2007

Woreda	Affected no. kebeles / total no. kebeles	Total population	Population in kebeles with recession agriculture along Omo River	Population in kebeles with grazing land flooded by Omo River	Estimated share of population dependent on Omo River	Ethnic groups affected
Selamago	9 /20	28,888	13,000	-	45%	Bodi, Mursi, Muguji
Nyangatom	11 / 20	28,695	15,557	-	54%	Nyangatom, Muguji, Murile
Hamer	3 / 35	61,349	1,793	-	3%	Karo
Dasenech	40 / 42	57,340	37,294	16,524	94%	Dasenech
Total	63 / 107	176,272	67,644	16,524	48%	-

Source: Based on kebele level data obtained from respective Woreda agriculture offices by the ESIR Consultant.

Ethnicity in the Downstream Area

The ESIA-DS Report presents the various ethnic groups in the impact area and describes their farming practices, agriculture calendar, cultural events and gender division of labour (pp. 76-83). Such information is important when planning in detail the livelihood improvement activities as each group will need specific attention to their traditions, needs and priorities. Most of these ethnic groups have, more or less, common socio-economic features but differ in the type and size of resources they own and the way they produce crops[16].

Agriculture and Livestock in the Downstream Area

Although the wealth of different ethnic groups in the arid lowland plains of Lower Omo is centred on pastoral production, agriculture play a more important part in their daily subsistence and it is the mainstay of the economy where cereals provide the bulk of the diet.

16 EPaRDA 2005: - Agronomic study in Hamer, Bena-Tsemay and Kuraz woredas. One exception is the Karo people, who do not herd cattle.

Farmers cultivate crops using residual moisture left from flooding of riverine and low areas. Their prime interest and focus of activity for men and boys is the livestock, which provide them with the greater part of their requirements in terms of food (milk, butter, blood, meat), clothing, social prestige and source of wealth. The growing of crops is peripheral but remains important to the women who has to provide food for the family. In these areas, rainfall is sparse and unreliable with an average annual precipitation rarely exceeding 400 mm and drought conditions occurring every two to three years. Mean average daily temperatures are around 30°C just north of Lake Turkana, becoming lower to the north, up the Omo Valley. In summer, maximum day temperatures reach the upper 40°. The main rains occur between March and May and the short rains fall in September and October. Crops are grown along the Omo riverbanks and in the bush belt, in which the latter is a type of rainfed agriculture.

The whole area is very remote and isolated. Recent tribal conflicts have further discouraged the introduction of an effective extension service. Apart from the work of some missions and NGO's which are assisting with small scale irrigation, animal and health programmes, little work has been done to introduce crop management practices through demonstrations to the farmers of the area.

Official land use figures are presented in the following table. Cropped lands occupy only marginal areas in the Hamer, Dasenech and Nyangatom woredas where only flood recession agriculture is feasible. In Selamago woreda better environmental conditions allow rainfed cultivation.

Table [12] - Actual land use, four woredas, South Omo Zone.

woreda	Crop land			Grazing land		Forest land	Cultivable land	Not cultivable land	Others	Total Area
	Perennial (ha)	Annual (ha)		(ha)		(ha)	(ha)	(ha)	(ha)	(ha)
Hamer	24	7,628	1%	225,434	31%	10,000	101,676	125,000	261,803	731,565
Dasenech		4,170	1%	85,364	26%	44,230	116,727	10,793	67,118	328,402
Nyangatom	3	4,892	4%	86,982	64%	400	20,000	20,000	3,908	136,185
Selamago	11,580	65,600	17%	135,100	35%	123,520	37,828	4,632	7,720	385,980
Total	11,607	82,290	5%	532,880	34%	178,150	276,231	160,425	340,549	1,582,132

Source: Pastoral, Agricultural and Rural Development Department, South Omo Zone, 2009

Rainfed agriculture

Rainfed crops are cultivated in three out of the four woredas where flood recession cropping is important: Hamer, Selamago and Nyangatom, at higher altitudes towards the west and eastern margins of the valley. Rainfall at lower altitudes, e.g. in Dasenech woreda, is insufficient to support any rainfed cropping.

Indigenous communities living in the northern part of the Lower Omo Valley, and the higher lands to the east and west of the river where rainfall is higher and more reliable practice rainfed cultivation which often relies on slash and burn practices in order to reach fertile soils. This, coupled with an ever-increasing population, puts greater pressure on available land resources. Rainfed cultivation fails every two or three years (sometimes two years in succession) because of a lack of rain, crop pests and/or birds.

Rainfed cropping systems can be broadly identified as:

- Maize dominated mixed cropping at the middle to higher altitudes,
- Sorghum dominated mixed cropping at lower altitudes, and
- Small-scale riverbank mixed cropping, also at lower altitudes.

The main crops grown are maize, sorghum, haricot beans, cowpeas, tobacco and occasionally pumpkins. Intercropping is the norm and low plant populations, due to wide plant spacing, reflect the little amount of rainfall expected. Labour for hoe cultivation and weeding is the main input, and is generally said to be in short supply due to the demands of livestock herding, low population levels and poor general health. Oxen are very rarely used, partly due to cultural objections and also because of losses to disease. These factors all tend to limit the size of the cultivated area. No fertiliser use is recorded and, in any case could be a wasted expense in view of the erratic rainfall. Farmers use their own seed of traditional, locally adapted short duration crop varieties.

No figures are available for the yields of rainfed cultivation. Many constraints affect this farming system which cannot be proposed as an alternative to increase agriculture productivity and improve the food production:

- The low and unreliable rainfall results in a short growing season which limits the choice of crop varieties, to those which have a lower yield potential. It also restricts the farmer to growing one crop per year. Where rainfall is low it is also likely to be unreliable and unevenly distributed during the growing season, resulting in regular crop failures.
- Rainfed cropping is practiced in areas that are mostly hilly and eroded and the amount of good arable land is limited.
- Compared to flood recession cropping, rainfed agriculture requires more labour for land preparation, especially where oxen are seldom used.

Estimated areas of rainfed cropping given in the ESIA-DS are about 18000 ha in the three woredas of Hamer (9300 ha), Selamago (7900 ha) and Nyangatom (500 ha), with an estimated annual production of about 15000 tonnes (mainly maize). The figure for particularly Hamer Woreda seems unlikely given the unfavourable soils and agro-climatic conditions.

Dasenech Hut

Karo Hut (Kara Korocho)

Inside the Dasenech hut

Temporary hut along the Omo river during recession cropping period

Nyangatom house (Kangaten).

Woman transporting water home near Omorate

Flood Recession Cultivation

Recession cultivation is a fundamental component of livelihoods throughout the lower Omo Basin. In most years, during August and September the Lower Omo Valley experiences seasonal river flooding, caused by heavy rains which fall upstream between April and August. The river overflows its banks and floods the land along its borders. Areas of about 30-50 meters large and some hundreds of meters long are flooded. The water recedes 2-3 weeks later to allow planting from September to October. Heavy flooding also renews oxbow lakes, such as Lake Dipa, giving access to large areas of well-inundated land for cultivation.

The variations and lack of accurate quantitative data concerning the cultivated areas are mainly related to the rainfall and flooding fluctuations. In 2001, a year of heavy rainfall, the extensive rains in the highlands produced big floods in the delta leading to above normal cultivated areas (about 6,200 ha), in 1999, a year of severe drought, the estimates were around 1,400 ha.

The plots of sorghum (main crop) cultivated by a household or family group are small in size, usually around 0.2-0.5 ha, all of which is cultivated by hoe. Families plant riverbank plots as the floods begin to retreat. Harvesting then takes place 3-4 months later, during one month period. This traditional land use is closely adapted to the water dynamics of the river. Although the size of cultivated areas can vary year to year depending on the height of the flood, it is the reliability of the harvest which makes this a fundamental practice for the region's food security.

Most communities practice flood recession cultivation, but the Dasenech group living in the river delta area is the most prominent in area and number of people practising this activity. The ESIA-DS (section 3.3.5.2) estimates that areas of cultivation can extend about 4,000-5,000 ha in the Dasenech woreda, with large scale sorghum dominated cropping on the flat delta islands. In the Nyangatom, Selamago and Hamer woredas small scale cropping is limited to riverbanks.

Figures regarding affected households in the ESIA-DS do not give detailed data about villages or communities that are dependent on flood recession cultivation. However, the ESIA-DS considers that about 20,000 households are engaged in flood recession and cropping in the delta on approximately 12,000 ha. This means that 100,000 people could be affected in the delta alone. The ESIR Consultant found that recession agriculture with water from the Omo River is practiced in 52 kebeles with a total population of around 67,600 persons[17]. The estimated annual crop production represents around 5,000 tonnes which in theory provide enough food for about 6 months. Sorghum yield figures given in the ESIA-DS are very low: 5 to 6 Quintal/ha. A rapid appraisal of the crops during the mission in February 2010 gave a highest value near 10-12 Q/ha, without taking into account the ratooning possibility. The planting density was estimated at about 1 planting hole per m² with a number of panicles of 5 per m².

Which, for a weight of 30 g per panicle gives a potential yield of 150 g per m², or 15 qx per ha. Given that the losses on the field and after harvest are the order of 30%, the estimated sorghum yield is about 10 qx per ha. Estimates of the ESIA-DS are based on average yields of about 10 qx per ha in the delta area and only 2 qx per ha further upstream.

An approximation of the cultivated areas on the river banks a dozen miles downstream of Omorate resulted in approximately 3 ha cultivated per km, which for a length of about 330 km amounts to 1,000 ha. This result corresponds to the analysis of satellite photos of the ESIA. The estimates obtained in the questionnaires (Table 3.32 of the ESIA-DS) in woredas of Selamago, Hamer and Nyangatom are much higher than previous data above mentioned.(4,241 ha), including the plots along the other rivers. A detailed reconnaissance would clear up the ambiguities that are associated with these estimates.

The Dasenech population living in the Omo delta and along the eastern banks of Lake Turkana in Kenya is estimated at about 55,000 people. Cultivation practiced on the large delta islands and along the seasonally flooded river banks provides virtually all the food production for the Dasenech – apart from all livestock products – and can even produce a grain surplus which is sold in local markets as Omorate, Turmi, and Jinka. Especially in Turmi, the grain produced in the Omo delta constitutes an important complementary food reserve for local pastoralists who seasonally enter into food shortage. Recession agriculture is particularly important to the Dasenech woreda with about 4000 to 5000 ha cultivated.

In the Selamago woreda it is estimated that 10,000 Mursi people[18] live along the Omo River and its tributaries and mainly practice recession agriculture. North of the Mursi's territory, Bodi people, who number about 6,000 also live and cultivate along both banks of the Omo River[19]. These ethnic groups have three main components to their livelihood system: flood recession cultivation, rainfed cultivation and cattle herding. All three elements are needed to support the population's food security. According to interpretation of satellite imagery less than 200 ha of recession agriculture is practiced in the Selemago Woreda.

Some Bodi people have moved further away from the Omo River and closer to the Dime Mountains east of their traditional territory where there is more rainfall. Many Bodi depend on lowland rainfed cultivation but as production is insufficient, they supplement this with either riverbank recession cultivation and/or rainfed cultivation on the lower slopes of the Dime Mountains. The daily diet of families depends heavily on maize or sorghum.

In the Nyangatom woreda, population is estimated by the ESIR Consultant to be 28,695, including Nyangatom, Muguji and Murile ethnic groups. The Nyangatom, who constitute the larger part of the woreda population, live mainly on the western bank of the Omo River opposite the Karo.

[17] See Appendix 6.

[18] International Rivers (2009), Facing Gibe III Dam: Indigenous Communities of Ethiopia's Lower Omo Valley, January 26 2009.

[19] Figures obtained from the Lower Omo Zone Administrative Office in Jinka indicate slightly lower figures, see Appendix 6.

They have access to two independent river systems, the Omo and the Kibish, as well as to an area of higher elevation and rainfall, where rainfed cultivation is possible, only during high rainfall years. Flood recession cultivation of the Omo and Kibish riverbanks is the most reliable source of food. The Nyangatom also have access to some flooded plains in the delta. They keep livestock and implement a rotational grazing pattern on riverbank plots before or after the season for recession cultivation. According to satellite images interpretation, less than 300 ha of recession agriculture is practiced in this woreda.

In the Hamer woreda the main flood recession areas are found on both sides of the lower Omo River as well as the banks of Lake Dipa and other smaller oxbow lakes. Karo population is estimated at 1,793 persons according to data from 2007 obtained by the ESIR Consultant. Ox-bow lakes such as Lake Dipa in Karo Korcho kebele, Lake Shoshe in Karo Lebuk kebele and Lake Wala of the Hamer woreda, are those lakes found along the Omo River that are used by the Karo people for flood recession cultivation, small scale irrigation, fishery, and dry season grazing. The annual flooding of the Omo River between July and September normally replenishes Lake Dipa.

When the lake level recedes the local communities start to plant crops like sorghum and maize two to three times per year. The Karo are nearly entirely dependent upon the Omo through recession cultivation, dry season pasture, tourism and fishing. An estimated 80% of the Karo's food supply is based on recession cultivation. The Karo also use fishing, beekeeping and small stock husbandry. Karo people live within their traditional settlement area, between Lake Dipa and the Omo-Usno confluence. This territory is also important to the Hamer pastoralists living further east. The Hamer population is estimated at 54,893. The Karo and Hamer groups are ethnically closely linked and due to limited grazing land in the Karo territory, cattle owned by Karo are looked after by Hamer people who get the milk. All offspring is eventually returned to the Karo owner together with the cattle.

The Hamer exchange goats and sheep for grain which is cultivated along the Omo River. While the territory of the Hamer ethnic groupdoes not include the riverbank, the community's well-being is highly dependent on the local resource economy which includes the seasonal flood cycle. Figures resulting from satellite imagery interpretation are low: less than 200 ha. In February 2010, Lake Dipa was dry as the consequence of two drought seasons and of the filling of the access canal during the 2008 floods. About 150-200 ha could be cultivated in the ox-bow lakes. The majority of the lower Omo population is dependent upon access to local natural resources and particularly highly dependent on the Omo River flood cycle. It is recognized by all that the dam construction and the seasonal flood reduction will disrupt the entire subsistence economy of the Lower Omo Valley and will totally modify traditional livelihoods based on flood-recession cultivation along the river banks and throughout the delta.

Present Irrigated Agriculture

Despite the presence of large flat areas suitable for irrigation, irrigated agriculture farming systems, are poorly developed in the South Omo lowlands, with less than 150 ha actually cultivated. The inaccessibility of the region, lack of roads and other infrastructure has not facilitated the implementation of irrigation infrastructure.

One large commercial irrigated farm installed on the defunct State Farm near Omorate, (Omo Higher Farm), which was established by the "Ethio-Korea Joint Agricultural Development Venture Project" during the Derg period to grow cotton, has recently been acquired by private foreign investors and is being developed to grow oil palm. About 1,000 ha have been rehabilitated and planted during the last two years. The cropping program envisages the plantation of 16,000 ha of palm trees. The Ethio-Korea State farm experimented with cotton irrigated cropping during a short period between 1989 and 1991. Cracks and sinkholes appeared in the canals when they were first filled and also in the irrigated fields.

Table [13] - Existing small scale irrigation schemes

Woreda	Localization	Implementation year	Management	Irrigable area - ha	Irrigated area - ha	Farmers concerned	Remarks
Dasenech	Awaga / Lubet 2	1999	MA/MWR	118	82	300	2 diesel pumps
	Omorate / Borkonech	2005	MA/MWR	25	-	-	1 diesel pump - not working
	Selegn	2005	EPARDA	32	12	80	1 diesel pump - lack of diesel
	Libemuket / Koro	2005	EPARDA	40	20	120	1 diesel pump
	Kapusia	2008	Private	50	10		Electric pump + 1 diesel pump
	Awaga / Lubet1	?	MA/MWR	20	-	-	
Hamer	Karo	2005	EPARDA	40	20	80	2 diesel pumps
	Kundama	?	EPARDA	40	-	-	1 diesel pump - not working
Nyangatom	Omo Kibbish	2006	EPARDA	105	?	480	4 diesel pumps
TOTAL				470	144	1060	

However, the cracks were repaired by backfilling and compaction using earth-moving equipment. and after three cropping seasons, the soils were reportedly stable. The irrigation scheme was designed for a full project area of about 10,000 ha, the farm was divided into fields or blocks of a nominal size of 36 ha; each block divided into four units for irrigation purposes. The farm was developed through a joint effort by the military Derg regime and the Korean Government. The project stopped when the new administration took over power 19 years ago in 1991.

Some small irrigated farms and small-scale irrigation schemes (abandoned or running) are found mainly in the lower reaches of the Omo River, because the banks of the river upstream are generally too high to permit efficient pumping.

Hamer women

Hamer man

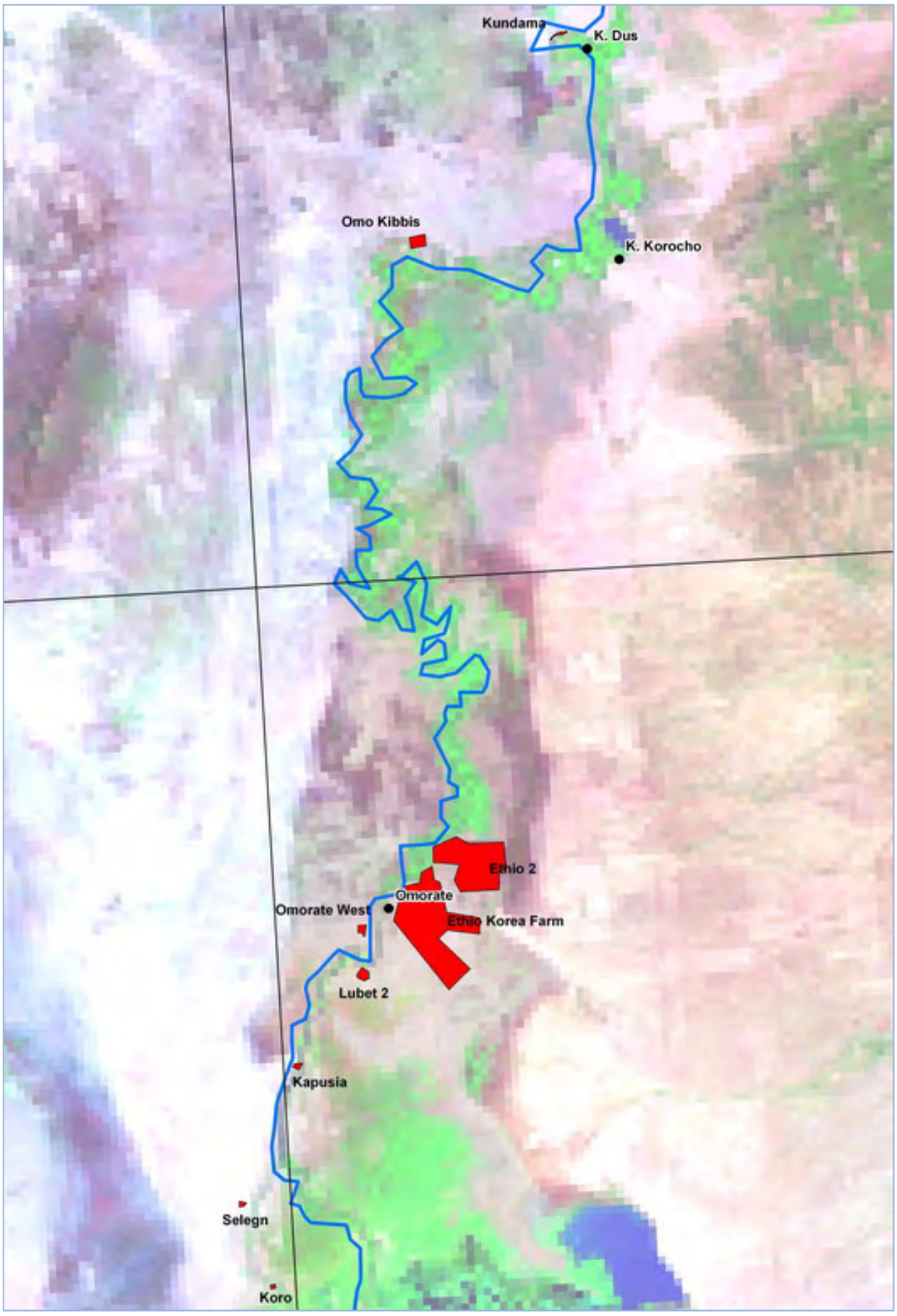
Hamer child

The weekly market in Turmi

Mursi women fully equipped to welcome tourist hordes

Woleyta youth at Zaro Kebele, location of Employers Permanent Camp.

Figure [14] – Existing irrigation schemes in lower Omo



These are mainly small farms (less than 0.5 ha) in the Dasenech woreda, for a total of about 20-30 ha growing high value crops like vegetables and fruits, particularly bananas, using windmills to extract water from the river. The windmills are very simple in construction – the actual costs of the windmills run up to 4,000-6,000 Birr – even to the extent that the vanes are fixed and do not swivel with a change in wind direction. Water is pumped by a vertical piston arrangement. The discharge is very low, about 0.3-0.5 l/sec, depending on the level of the river. Water is led by furrows to the crops. Individual farm sizes are in the range of 0.25-0.5 ha.

Six small scale irrigation schemes, less than 100 ha, were implemented by the Government and the EPaRDA NGO during the last decade. Their location is shown Figure below.

In the Dasenech woreda, at Lobet 2 kebele near Omorate, the Ministry of Agriculture and Rural Development has implemented a small scale irrigation scheme of 118 ha (see photos) supplied by a permanent 2-pumps station on the Omo River. Only 82 ha are actually cultivated by a total of 300 local farmers. Some demonstration and training parcels include agro-forestry crops: *Leucaena leucocephala* and *Moringa oleifera,* as well as the pasture/forage grasses, *Panicum maximum* and *Chloris gayana* (Rhodes grass). Irrigated plots of 0.25ha have been allocated to local farmers as training farms, where they grow two crops per year of sorghum and maize, bananas, mangoes, and vegetables (tomatoes, onions).

During the last decade, EPaRDA[20] has introduced irrigated cultivation in four sites namely Karo (Hamer woreda); Libemuket / Lochuch and Selegn (Dasenech woreda); and Omo Kibish (Nyangatom woreda). In these irrigation schemes, around 2000 pastoralist and agro-pastoralist households have benefited from a total area of close to 400 hectares. Irrigation water is provided free of charge.

However the present level of irrigation development is minimal (about 30% of the equipped area is cultivated). This is due to a number of reasons including inconsistent access to fuel, no local expertise, no spare parts for maintenance, no car transport, damage caused by annual flooding, low river levels in the dry season (too low for pumping) and limited market development.

There is no evaluation of the results of the implementation of these small scale irrigation schemes. These schemes were well received and the results of the first campaigns were promising when technical support was present. But their current degradation is mainly linked to the farmers' inability to face the maintenance and operation expenses. This lack of resources cannot in the long run be compensated neither by EPARDA nor by the government.

No statistics data are available on the outputs of these schemes or on the actual participation of the beneficiaries. The human, financial and material resources available in the official agriculture services are currently insufficient to ensure the technical assistance and to allow normal operation and increased production.

Irrigated agriculture practiced on the small scale irrigation schemes and flood recession agriculture are both fundamentally based on grains production (sorghum and maize). Cultural practices differ only in land preparation and irrigation which require special availability of labor-intensive intervention (men). All other works are done either by women and girls (planting, weeding, harvesting and transporting the products) or boys (birds scaring). The use of fertilizers and pesticides is almost non-existent in both cases.

Omo-Kibish Small-Scale Irrigation Project

The first small scale irrigation conducted by EPaRDA was 'The Omo–Kibish Small-Scale Irrigation Project'. It was a World Bank funded government program implemented in partnership with the Federal and Regional Pastoralist Community Development Program (PCDP) from 2005-2006.

The project supports the agro-pastoral community in Kangaten area of Nyangatom woreda. The aim of the project is to improve the livelihood and food security of the beneficiary community through promotion of irrigation farming as well as provision of training and extension services.

The livelihood of the community depends mainly on livestock rearing. The small amount and erratic nature of rainfall makes rainfed farming in Kangaten unreliable. Therefore, traditional food crop production mainly depends on the overflow and recession of the Omo River. In addition, unbalanced livestock density and feed availability, inadequate extension service, post harvest handling loss, disease and pest damage, and lack of farm tools have been the main pitfalls of the traditional farming practices in the area.

Farming groups have been organized at three locations (Naptokoit, Dypa and Kangaten area). As part of the project's capacity building efforts, the beneficiary communities receive training specifically on awareness raising, systems of lowland agricultural production, timing of irrigation and proper watering of crops, methods of water conservation, techniques of seed bed preparation and crop husbandry, methods of weed controlling weeds and other related issues.

[20] Enhancing Pastoralist Research and Development Alternatives – non-governmental organization established in 1999 – working mainly in South Omo Zone.

Main irrigation canals were surveyed and constructed with participation of the community. Early maturing seeds, farm tools, fuel and lubricants are supplied. Two vehicles and four water pumps that were in place for a previous similar project are maintained and utilized for the project purpose. 400 households are now directly involved and benefit from this irrigation activity. Many of these are female-headed households. A total of 70 hectares of land is being surveyed, prepared, irrigated and planted with food crops by the beneficiary communities. The beneficiary communities mainly plant sorghum, maize and haricot-beans supplied by the project. The government has recently taken over the scheme with a plan to expand it to 200 ha for 800 households.

Karo Small Scale Irrigation Project

The livelihood of the Karo community in the Hamer woreda depends mainly on recession agriculture. They were pastoralists until bovine pests killed their herds. EPaRDA took the initiative to introduce small scale irrigation to the community in 2005. The project was implemented through the funding of SIDA/SLUF (Sweden International Development Association/Sustainable Land Use Forum). This project was phased out in 2006, however EPaRDA continued to support the beneficiary community by providing some inputs and other technical support through Cordaid funding.

The aim of the project is to improve the livelihood and food security of the beneficiary community through the introduction of irrigation farming and provision of training and extension services. EPaRDA organizes the communities into pastoralist associations and provides awareness creation programs. Five people from Dasenech community were invited to share their experience with the Karo. A pilot irrigation farm was established and demonstrated to the community. In addition, a nursery and fodder demonstration site was also established and cash crops seedlings raised such as onion, sweet potatoes and beans, as well as several types of fruit trees.

The beneficiaries easily adopted the irrigation technology and harvested sorghum successfully. 40 hectares of land around the Omo Riverbank were surveyed, cleared, irrigated and planted. A 1,310 meters long main canal was constructed. Farm tools, water pump, fuel and lubricant were supplied to beneficiaries.

A water users committee, which includes local leaders, elders and beneficiaries of the irrigation farming, has been formed. It serves to allocate water fairly and equitably among the members, mobilize the beneficiaries to take care of the canal, and mediate and settle emerging conflicts. 120 households are directly involved and benefit from this irrigation activity.

Windmill along the Omo river; too high head during the dry season…

…reduces discharge and irrigable area

Small irrigation from windmill pump

Motor pump along the Omo

New irrigation holding

Recession agriculture on the terraces of the Lower Omo

Cropping pattern – Water requirements

The cropping pattern generally involves the cultivation of two major crops: maize (60-70%) which can be sown twice a year and sorghum (30-40 %) with the possibility of a ratoon crop. Some small parcels are also cultivated with vegetables (mainly tomatoes, onions and sweet potatoes) and fruit (mainly bananas). Crop water requirements were calculated using the FAO methodology (see Appendix [7]). Standard crop coefficients were used. A summary of the data used is given in the table below. Depending of the cropping intensity and taking into account an irrigation efficiency of 70% the irrigation water requirements vary from 10,000 to 18,000 m3 per ha.

Table [14] - Irrigation water requirements – m3/ha

	Jan	Feb	Mar	Apr	May	June	July	Agust	Sep	Oct	Nov	Dec	Total
Sorghum 1													
m3/ha	1424									631	1443	1872	5 371
Sorghum 2													
m3/ha			541	1143	1864	1432							4 980
Sorghum (2h)													
m3/ha	1424	1216	1891	1216	336					631	1443	1872	10 030
Sorghum (2h)													
m3/ha			541	1143	1864	1432	1104	1997	1604	368			10 053
Maïze													
m3/ha	616	1523	2302	1764	749								6 954
Maïze													
m3/ha					439	1553	2304	2226	815				7 336
Maïze													
m3/ha	2251	844								580	1375	1698	6 748
Maïze													
m3/ha							309	1090	2150	2267	1337		7 153
Sesame													
m3/ha	156								51	150	210	218	7 846
Cotton													
m3/ha							385	1493	2132	2235	1754	677	8 676
Sm..vegetables													
m3/ha	2135	1310									1294	1841	6 579
Tomato													
m3/ha			721	1170	2149	2327	1743						8 110
Tomato													
m3/ha	1868								1149	1548	2060	2164	8 789
Groundnuts													
m3/ha						834	1569	2312	2089	954			7 758
Groundnuts													
m3/ha			446	799	2121	2327	1558						7 251
Groundnuts													
m3/ha	1998	445							253	913	1842	2177	7 629
Beans													
m3/ha			767	1535	2191	2245	798						7 537
Bananas													
m3/ha	2032	1996	1905	1548	1899	2238	2297	2413	600	2292	2191	1620	23 031
Oil palm													
m3/ha	1416	1396	1288	940	1252	1831	1906	2011	600	1908	1817	1323	17 688

Start Development middle Senescence

Livestock

Most indigenous people living in the four downstream woredas are pastoralists or agro-pastoralists. A great part of their material and immaterial culture relies on pastoral issues. In general, the villages situated close to the Omo River have a share in recession agriculture along the riverbank, and may be considered as agro-pastoralists or riverine pastoralists, as they manage both agriculture and livestock. Those who are situated at a distance from the river depend mainly or entirely on livestock raising. For example, in the Dasenech woreda more than 70% of the population are riverine pastoralists, and less than 30% are "pure pastoralists".

It is generally the men who look after the cattle, taking them to the water bodies to drink, then to the fields to graze, providing solutions when they are ill. The males also decide about the distribution of products to the household members when an animal is sold. Some children look after the younger animals or the goats, and take them to the water or grazing areas. Women are responsible of most agricultural and domestic tasks. This has implications in terms of potential impacts and mitigation measures.

Livestock is a source of food, hides, money, product exchange and social prestige. In pastoral and agro-pastoral communities, wealth is judged according to the amount of animals (especially cattle) a household owns. Cattle-wealthy men may also have more wives.

"Pure pastoralists" who do not produce crops get food by selling an animal (goat, sheep, cow or ox) at a town or informal market, and buying sorghum (or to a lesser extent maize). Milk from goats or cows is also one of their main basic foods. Meat and blood can be eaten at special occasions or in times of scarcity (e.g. drought). This shows the importance of livestock for the food security of the populations.

According to the ESIA-DS, there are 448,955 goats, 447,882 cattle, 256,351 sheep, 71,880 poultry, 37,613 donkeys and 344 camels in the four downstream woredas. Cows and oxen are preferred, but dry conditions and unavailability of good pasture tend to induce higher possession of goats, especially in the driest Dasenech woreda.

Forage and grazing lands are one of the main issues for pastoralists. Even if crop residues are sometimes used, natural pasture is the main source of food for the herds.

In the ESIA-Ds, grassland cover is estimated at 46,269, 30,920, 17,500 and 4,540 ha., respectively, in the Dasenech, Nyangatom, Selamago and Hamer woredas, amounting to almost 100,000 ha. They are typical for the lower Omo plain. Species like *Cenchrus sp. Digitaria sp., Pennisetum sp, Enteropogon macrostachyus*, and *Elusine sp*. were found in the lower Omo. The saline area of lacustrine pasture near Lake Turkana is very heavily grazed for much of the year and the close swards are composed almost entirely of two grasses: *Sporobolus spicatus* and *Brachiara sp. Leptochloa fusca* also occurs near the water's edge. The grassland suffers from seasonal surface water logging and burning. However this site is used as dry season grazing.

Pastoral people are highly mobile. Overall, mobility is organized seasonally according to water and pasture. The Omo River is one of the main sources of water both for animals and people. Other water points in the dry season include governmental water wells, rainwater collectors and oxbow lakes. The best pasture areas during the dry season are found in the delta and near Lake Turkana. The plains there are seasonally flooded by the river and/or by the lake. With the natural decreasing of the level of the Lake Turkana and oxbow lakes in the dry season, the areas previously under water become good pasture areas.

Today, pastoral equilibrium is affected by a series of pressures such as demographic increase, overgrazing, reduction of available land, conflicts, etc. Pastoralists are becoming more vulnerable to drought. Insufficiently fed animals during droughts produce less milk, reproduce less and are more prone to diseases. Overall, as water and grazing lands tend to become scarce, droughts more severely felt and livestock raising more difficult, there is a tendency to shift from pastoralism to agro-pastoralism, changing mobility patterns towards semi-nomadism. Conflict with other ethnic groups, such as between Dasenech and Turkanas living near the lake in Kenya, also sometimes force people to reduce their mobility.

In spite of these problems, pastoralism and agro-pastoralism is a way of life highly adapted to an extremely harsh environment, taking advantage of very few resources available and almost no state services in order to sustain a critical population. However, pastoralist families practicing livestock raising and recession agriculture show adaptive capacities and could probably, if needed, replace recession agriculture by irrigated agriculture without major cultural change, provided the bulk of work does not increase (which would probably fall on the women's shoulders).

Fisheries

Distribution of Activity

The ESIA report does not describe the situation including the numbers of professional and occasional fishermen; the report estimated the potential of the Omo River to 500 t, which could be exploited annually by 200 fishermen. However this is only an assumption and the opinion of the ESIR Consultant is that the number of professional fishermen at present is far below this figure. Only few nets and fishermen were encountered during a boat trip on the lower Omo, while the period (January) was favorable for fishing activities (limited flow and agriculture activities).

There is no significant fishery activity in the Omo River near the dam site or further upstream in the future reservoir area.

In the downstream area, fishery is a minor activity among the local population who mostly share their time between agriculture and livestock. Apparently, there may only be a few dozen professional fishermen who make their living only through capture fisheries. Downstream, and up to Lake Turkana, fishing is carried out mainly by farmers who catch fish from time to time, mostly for home consumption.

There is no commercial fishery in the Omo River proper, main catches occurring in Lake Turkana where a private enterprise collects, freezes and carries filleted fish to Arba Minch and Addis Ababa. The professional fishermen of Omorate sell fish to consumers but there is no formal market to promote the product.

Seasonality of Activity

Occasional fishermen who practice agriculture on the banks of the river mainly use their nets after the high water period level (August to October), starting in November through the dry season. Professional fishermen mention that they go fishing everyday, even during high flows, when (according to them) big fish (Distichodus, Nile perch, Clarias) can be caught during migration. Professionals indicate that their catches are at minimum when the water level is low.

Gears

The most commonly used gears consist of wood canoes, gill nets, hooks and lines, and sometimes spears. Given the cost of a canoe (600 birr), 2 fishermen generally share it, and use it alternatively. Professional fishermen seem to work yearlong. The nets consist of 50m long multi filament gillnets (1.50 to 3m in height) with a mesh size of 5 to 8 cm (knot to knot) generally purchased from Arba Minch. This type of net only allows catch of large size fish from 1 kg and above. Specimen of 5 -6 kg are mentioned by the fishers. The habit seems to use one or two nets at a time and their duration is more or less 6 months.

Hooks and lines are less used, mainly because of a lack of availability of the market. Spears (harpoons) are mainly utilized in depressions and low level water during the dry season (this has been observed in Dipa oxbow-lake, where children were using such locally made harpoons). However this oral information collected during a few days in the field needs to be verified and a survey appears necessary to get the full picture.

Fish Marketing

Fish caught in the Omo River are mainly consumed by the fishermen themselves; if more than home needs are available, then the remaining part is sold locally. Professional fishermen eat fish everyday and sell most of their catch: there is no fish market as such, but sales occur in the villages: generally the fisherman's wife is in charge of the sale. Drying fish is not frequent at household level, but occurs from time to time, both to preserve the non-sold product and to vary diet.

In Lake Turkana, 3 species of Tilapia (*Oreochromis niloticus, Sarotherodon galilaeus, Tilapia zillii*) are dried and then sold to enterprises which export the product to Kenya and Somalia (see picture above).

One enterprise located in Omorate, Omo River Trade Ltd, is purchasing filleted species, (mainly Nile perch) and whole fish (*Heterotis, Tilapia, Distichodus*) from fishers working in Lake Turkana; but not from Omo River, as fish supply being insufficient and irregular.

Cold storage (-18°C) allows for production of ice and storage of the different products before sending them by refrigerated truck (one ton capacity) to Addis Ababa. Fish from Lake Turkana is carried with ice before being frozen and stored in the cold room. The filleted fish purchased at Lake Turkana fetch 16 birr per kg and is sold in Addis Ababa, mainly to hotels and restaurants; a part of it is also available in retailers shops scattered in the capital.

Other Sources of Livelihood in the Downstream Area

Apiculture

According to the ESIA study, honey production is an important activity downstream, with 132,500 bee colonies[21] in the four woredas: 90,000 in Hamer, 27,500 in Selamago, 10,000 in Dasenech and 5,000 in Nyangatom. Beekeeping is said to be an important activity for the Murile and a dietary supplement for the Kwegu, the Karo, the Mursi and the Nyangatom. The ESIA-DS further asserts that some traders buy the honey "at rural markets from farm households", without giving more precision about the location of these markets and the amount of sales realized. They then sell the honey to urban centres such as Jinka. Prices are assumed to vary from 10.5 to 15 Birr per kg, but no average production figure is given in the study. Honey production may have important potential downstream, as shown by the fact that there are four cooperatives in the Maji woreda, with 485 members.

Hunting and gathering

Information on hunting and gathering found in the ESIA is essentially qualitative due to the difficulty of evaluating quantities of food for these activities. As far as gathering is concerned, it is stated that the Murile, Kwegu and Nyangatom are complementing their diet by gathering wild food, and that collecting fuelwood or roots and leaves that are generally not eaten is part of the coping strategies within the food-unstable woredas. There is no systematic analysis of these gathering and collecting activities in terms of importance for the diet or income generation by ethnic group.

On the contrary, hunting is much better reviewed, e.g. with a table of the perceived importance in local diet, presence of wildlife in the local environment and perceived population trend in 26 selected kebeles of the four woredas. It shows that hunting remains an important component of the local diet in these kebeles even though the population of wild animals is severely decreasing. According to the same report, this is due to widespread hunting by pastoralists with semi-automatic weapons. In particular, it is assumed that the Murile, Kwegu, Mursi, Karo and Nyangatom are practicing hunting in order to complement their diet.

[21] ESIA-DS, p 101. However, these figures are taken from the woreda offices and were not verified by systematic field investigation.

Preparation of Nile Perch (Lates niloticus) filets on Turkana lake-shore

Nile Crocodile head abandoned on the lakeshore

Fishing boat on Lake Turkana

Fisherman repairing a fishing net on Lake Turkanas shore

Dried fish ready for sale (Tilapia nilotica

Oreochromis niloticus from Lake Turkana

Tourism

The Lower Omo region is a tourist destination for a few thousands tourists every year (figures differ according to the sources) and has important potential to increase in the future (e.g. Omo and Mago national Parks, Tama Wildlife Reserve, the Murule Control Hunting Area, Lake Turkana). However, it is constrained by the lack of asphalted roads, accommodation (hotels) and tourist infrastructure.

The ESIA reports give an overview of the tourist activities in the four woredas. Even though the infrastructure is very limited (3 hotels in total, roads in a very bad state, etc.), some 300 tourists per month are estimated to visit the area, which has a lot of potential for tourists, even outside the Omo and Mago National Parks. However, very little is elaborated about tourist activities directly benefiting the communities living along the river. "Community tourism" is mentioned, mainly consisting of boat trips from Lake Turkana into the Omo River and National Parks. Ecotourism, sport activities, tourist fishing and hunting are also mentioned. Tourism is viewed as both potentially benefiting from the dam stabilization of the flow and as an underdeveloped and promising activity for development packages accompanying the Gibe III project. However, no prefeasibility study is made about the potential for developing tourism as a livelihood restoration for the affected people.

According to the ESIR Consultant's observations, tourism is not a major livelihood source for most of the PAPs within the four woredas. However, the consultant found that some of the villages generate some income from tourism, especially in Karo (e.g. Kara Korocho, promoted by USAID) and Mursi territory. In these areas, as well as among other ethnic groups (e.g. Dasenech, Hamer, etc.), tourists are attracted by the particularities of the ethnic groups who may charge money for entering their villages, using their facilities (parking) or taking pictures of them, either on a community or an individual basis. Further studies need to be undertaken in order to formulate income-generating projects directly benefiting the ethnic minority groupsand not only to remote operators based in Addis Ababa or in other urban centres.

Food Relief

Some food relief has been distributed by the government and NGOs to compensate for failures or provide relief during drought and floods. In the literature, food insecurity in the region is generally attributed to a wide range of social factors, changes in the environmental conditions, or simply to natural factors.

The ESIA studies highlight the fact that food aid is an important component of the concerned indigenous people's livelihoods. Up to 50% of their livelihoods is said to be provided by external relief, and it is claimed that grain production from recession agriculture is only sufficient for 3 to 6 months. Additionally, crop failure due to drought, pests and the like would occur at least every three years; "basically the whole area is food insecure and famine relief is required in most years."

However, at the same time it is recognized that some groups like the Karo can be self-sufficient and sometimes even generate surplus, and that overall crop production amounts to 5,000 tons per year, "which may be some indication of the extra amount of food aid which might be required if there was no controlled flooding after dam construction."This appears as a major inconsistency in the analysis which needs careful revision.

In addition, no household and individual analysis is proposed about food consumption (sorghum, milk and complementary products), both required and consumed. Data is also lacking concerning the exact quantities of food relief actually distributed in the last years, which would give a more precise idea of the extent of food insecurity, eventually smaller than asserted in the ESIA studies.

However, the ESIA-DS does present information on the severity of water and food strains during the drought years of 1997 and 1998 as well as how the response from emergence food assistance was perceived. The overall picture is that food insufficiency in those two years was worst in Dasenech and Nyangatom Woredas and that assistance given was adequately or plenty.

Finally, food aid in the ESIA-DS is foreseen mainly as a compensation measure during reservoir filling, for a price of 30 million ETB per year, for two years. If populations were in need of food for more than 6 months a year, the amount of relief necessary would be higher than the recession agriculture yields.

There is no systematic data or monitoring of the amount of food relief provided to the population in the South Omo Zone, as the census and statistical data are generally made at country level. In December 2005, USAID evaluated that in the South Omo Pastoral Livelihood Zone, "All wealth groups have received annual relief food amounting to 8-14% of annual food requirement"[22], whereas in the Salamago Pastoral Livelihood Zone "The zone has been more or less food secure, and has received little food aid over recent years"[23].

In August 2009, it was stated that because of recent crop failures and lack of rain, "food insecurity remains high in most parts of the SNNPR, particularly in South Omo [and other areas]. (...) Pasture and water shortages are critical (... and) early migration has started." Conflicts around water and pasture resources at the Kenyan border and acute malnutrition were resulting in the study area[24].

In 2009, the Productive Safety Net Programme (PSNP) of the WFP was supporting a few thousands households in the Dasenech, Nyangatom and Hamer woredas. It is important to note that this was not provided as main source of food but as a supplement to avoid malnutrition.

[22] (USAID – SNPRR regional overview, p 33).

[23] Ibid.

[24] (WFP and USAID, Food Security Update, August 2009, p 2-3).

In the beginning of 2010, the food security in the South Omo zone was evaluated as "moderately food insecure", with recommendations on "continued food and non-food assistance [as] important to prevent further deterioration."[25]

Among the respondents to interviews undertaken by the ESIR Consultant, the majority received food aid in the form of Food-for-Work for one to two months per year. It should be added that these interviews by no means constitute a representative sample.

In short, the consultant recommends additional studies about relief help, nutrition and agricultural yields in order to have a clearer and more accurate picture of food security for potential PAPs. Precise monitoring and data collection should be prioritised by the Project in order to ensure a proper intervention and follow-up.

Social Development

Health

The health situation in the three woredas affected by the Reservoir, Chida-Sodo Road realignment and permanent camp is only very sketchily described in the RAP, listing the number of cases with physical and mental disabilities as well as number of deaths within the previous 12 months. However, there is no description of the most prevalent diseases or listing of causes of the deaths mentioned.

Health coverage and services available in the impact area (including most of the woredas surrounding the future reservoir) are well presented.

In the downstream area the health status is described as poor, which is documented by statistics from the woreda health offices. The most prevalent diseases are malaria (43% of all cases reported), intestinal parasites (11%) and upper respiratory infections (11%). Comparison between the North Omo Zone, South Omo Zone and the SNNPR as a whole documents the poor state of health, especially in the South Omo Zone.

The assessment of health services in the four woredas by the ESIA-DS is that the ratio of health facilities to population is far below standards of the Ministry of Health. It was observed during the ESIR mission that some of the health posts are unmanned and ill-equipped.

The capacity of the various health facilities has not been assessed in any of the affected areas. Neither is there a description of how sick people actually seek treatment for their ailments. Data obtained from the Omo-Gibe River Basin Development Master Plan (1996) gives an indication that health stations are less used in the South Omo Zone and traditional methods are more popular than in the Region (SNNPR) in general. Data for why sick people do not seek treatment is incomplete but still gives a hint that health facilities do not sufficiently reach those who need them and that these people often do not have finances to cover these services.

[25] (USAID and WFP, ETHIOPIA Food Security Outlook, January to June 2010).

Vulnerable Groups

The RAP discusses the importance of identification of vulnerable persons among the PAPs[26] as these potentially could need special attention during project implementation. From the defined criteria 114 persons are identified as vulnerable along the Chida-Sodo Road. Compared with the total population of 6,223 persons in the 18 affected kebeles , vulnerable households constitute 1.8%. The RAP suggests including the 45 households who stand to lose their house and more than 50% of their farm land[27]. While these are not vulnerable per se, they are certainly severely affected by the project. Additionally, it is surprising that the 71 landless households / households without land certificate are not included among the vulnerable groups[28]. There is possibly some overlap between these groups but this is not documented. As mentioned in the RAP, part of this group might have land but are without certificate proving their ownership[29]. International social safeguards require that PAPs with only customary rights to their land are recognized as legal landholder prior to resettlement[30].

Despite presentation of much of the demographic data, there is no comment on a seemingly alarming discrepancy between the numbers of men and women in some kebeles. Whereas this anomaly could be caused by typing errors, any situation where women account for less than 95% of the number of men should be investigated. Possible explanations could include migration but in more severe cases women in the area could have a higher mortality, which would have to be addressed by the project in one way or another. In the current situation, there are significantly less women than men in Gocho and Mogisa Kebeles in Kindo Didaye Woreda with only 2% and 34% of the total population, respectively. In all other kebeles, men are outnumbering women.

Following the lack of detailed baseline data there is no information on vulnerable persons in the downstream area. However, the report displays an understanding of the concept 'vulnerability' that could cover the majority of PAPs. One of the two categories of vulnerable people is defined as women, youth and elders within the greater project area but not directly affected, whereas the other is characterized as "potentially directly affected (riverine) Kebele households".

[26] These are identified as female heads of households, elderly heads of households (above 65 years), young heads of households (below 15 years) and persons with disabilities, see RAP, p. 55.

Whereas PAP refer to Project Affected People in general, it is more appropriate to talk about Project Affected Household (PAH), when one wants to describe the entire household as a unit. This applies also to entitlements, which are applied to households and not individual persons.

[27] RAP p.. 128. In a previous section, the RAP recommends to include as vulnerable the seven households who will lose their house and more than 80%of their land; p. 76.

[28] RAP, p. 56. The survey has not distinguished between landless households and those without certificate.

[29] The Council of Ministers Regulation no. 135/2007, Article 22, stipulates that "Any person who claims for payment for compensation in accordance with the Proclamation and these Regulations shall produce proof of legitimate possession of the expropriated landholding and ownership of the property entitling compensation".

[30] See e.g. World Banks OP 4.10, § 17.

Hence the category 'vulnerable' loses its power to identify and target those people who are particularly at risk vis-à-vis the Gibe III Project impacts. A genuine assessment of vulnerable groups should be carried out, as it is done in the area affected by the Chida-Sodo Road realignment and Employers Permanent Camp.

Disaster situations in the Downstream Area

Floods

The study area is regularly struck by disastrous floods and droughts, where frequency and scale are difficult to determine because of lack of monitoring, i.e. no meteorological station or river level monitoring; very little information on the local consequences of droughts and floods; no systematic data on the consequences of past disasters.

Floods exceeding certain thresholds may be detrimental to the people depending on the Omo River. Major floods which caused loss of life and property occurred in different parts of the country in 1988, 1993, 1994, 1995, 1996 and 2006. For example in the 2006 main rainy season (June- September), flood in the Omo region resulted in the death of more than 364 people, and more than 6,000 people displaced due the flooding of about 14 villages (NMA, 2006). Additionally, more than 900 livestock drowned 2,700 heads of cattle and 760 traditional silos were washed away (WFP). Floods also make irrigation more difficult.

The ethnic minorities interviewed by the ESIR consultant expressed the need for a certain amount of water and water variation. If the level is too low (during droughts), or if the flood is too brutal, it is detrimental for recession agriculture and has consequences for food security. People repeatedly complained to the consultant about the "low level" of the river impeding recession agriculture, inducing hunger and even starvation. On the other hand, a flash flood may also be detrimental to the harvests, as it occurred in 2006. In short, in the present situation the agro-pastoralists and people depending on their activities need a definite seasonal river level and flow for their survival each year, neither too low, nor too forceful. The dam would definitely have a positive role by reducing the flash floods, but without compensation measures the water level would be too low for recession agriculture.

Droughts

Drought patterns are mentioned elsewhere in the report. Vulnerability and coping capacities have been gathered by the consultant, especially among the Dasenech who live in the driest areas.

Vulnerability to drought is a very complex issue. There are differences between 'pure pastoralists' who do not grow crops, and agro-pastoralists. On the one hand, those who grow crops may have more access to sorghum, which makes them less prone to famines. On the other hand, if the crops are affected by the drought, either for lack of moisture, absence of riverbank flooding, or pests, they may have less alternative options than those who focus entirely on livestock.

The 'pure pastoralists' generally depend on the people living near the riverbanks, as they too need sorghum and get it by exchanging an animal to the riverine pastoralists for a certain amount of sorghum. When the crops fail, trade becomes limited or non-existent, hindering the food provision of the pastoralists. Drought has also strong impacts on livestock as it affects animal feeding: with the reduction of pasture available, the animals do not get enough food. Thus they cannot gain sufficient weight or reproduce, and they have low yields of milk. They sometimes even die and are more vulnerable to diseases. Consequently, milk consumption is reduced, as is the overall number of animals.

Drought also increases competition on the remaining grazing lands, increasing the likelihood of conflict occurrence.

According to interviews carried out by the ESIR consultant among the indigenous people these persistently expressed their suffering related to the effects of drought: insufficient water level, dry wind, crops failure, insufficient animal feeding and decrease in livestock yield. Many respondents felt that the frequency of droughts was increasing through time, and perceived an increasing sensation of heat and difficulty to stay in the sun.

Perceptions found in the literature are quite similar, people expressing an increasing suffering from multiple droughts, increasing heat and instability of the rainfall patterns[31].

However, similarly to flooding, regular drought is part of the normal annual season in the region, and communities have developed specific coping mechanisms to adaptation to its impacts.

Community adaptation means

Increased mobility is one of the main adaptation measures. There is regular seasonal mobility to adapt to the seasonal variations of natural resources. In case of prolonged drought, there is also more contingent mobility, as the cattle is brought further to the remaining water points and grazing areas.

Indigenous social security and sharing system: social arrangements sometimes provide important assets to cope with droughts by rationalising land use, resource use or redistribution schemes within the community. Sharing food, resources or livestock, and herding partnerships are common[32]. Resource sharing within the community is also a response.

Preservation of rangeland is another type of social adaptation. Rotational grazing, seasonal rangeland differentiation into wet and dry season grazing reserves, and social management of grazing areas may be implemented by the community leaders through their traditional institutions.

Other community means comprise **herd diversification,** arable **land renting,** and sometimes even **violence**: raids, land extortion.

[31] Cordaid and FSS (2009), Community Perspectives on Climate Change Impacts and the Responses in the Southern Lowlands of Ethiopia, Addis Ababa, June 2009.

[32] Ibid.

Household adaptation means

Households too have developed specific adaptation means for the times of scarcity. Some gather firewood from the bush and sell it to the town people, then purchase food. Others slaughter more animals then drink their blood and eat their meat, or sell them in the towns in order to buy food. They may also rely more on milk and other animal products.

One of the coping mechanisms in times of scarcity is provided by social bonds. For example, some of the poorest people, such as elders, get their food from relatives. Other people living far away from the river cover huge distances on foot in order to reach friends, bond with partners or relatives who have access to agricultural lands and ask them or beg for food.

Children may be sent to relatives or to governmental educational pensions where they may live on a permanent basis.

People also collect leaves, berries, roots, nuts, fruits and other wild food plants as a supplement diet, especially wild fruits or tubers.

Some people also increase their exposure to tourists in order to get some cash.

Finally, when other means result insufficient, consumptions adjustments are the ultimate solution, either by eating seeds or non-mature crops, or by reducing overall food intake.

Least vulnerable people include the dominant clans, who get regular tributes from clans of lower rank; people with large cattle herds, who have more milk or may easier sell animals; people able to significantly increase their mobility; and people practicing irrigated agriculture. Most vulnerable people include women, children, least powerful clans, and people depending mostly on recession agriculture.

Security and Stability Issues in the Downstream Area

Regional Stability

The stability of the region is linked to the problem of the Ilemi Triangle, an area of approximately 10,000 to 14,000 km², constantly disputed since colonial times between Sudan, Kenya and Ethiopia and situated at the end of the study area to the west of Lake Turkana. It is at stake mostly for the various pastoral indigenous people using its vast pasture lands during the dry season, such as the Ethiopian Dasenech and Nyangatom, the Kenyan Turkana and the Sudanese Toposa.

Its borders have never been categorically settled for various reasons, such as the strategies of the colonial powers and subsequently of the concerned countries, lack of interest to settle the dispute, the remoteness of the area and the difficulty to control it for logistical reasons and because of its instability in terms of security. The pastoralists using its vast pasture lands have developed both inter-community social agreements and recurrent violent raids for cattle rustling, sometimes with human casualties. Historically, they have been used as assets in the national strategies of territorial claims, being armed by their respective governments.

Additionally, Southern Sudan is rich in oil reserves which are increasingly exploited, especially since the peace agreements in 2005. This increases national and international interest in developing the area. However, tensions between the north and the southern Sudan are again increasing, and the oil interests at national and international level may have detrimental effects on the regional stability and put additional pressure on the people living in or near this area, being trapped in a regional power game.

Conflicts

The downstream area in general, and especially the areas bordering with Sudan and Kenya, are periodically affected by inter-ethnic conflicts under the form of raids to capture cattle, murder of members of different ethnic groups, clashes around water and grazing areas during the dry season, around fishing plots at Lake Turkana or recession agriculture areas. This deeply affects the lives and livelihoods of the people, with numerous deaths of people and cattle, forced migrations and restriction of free movement vital for the traditional pastoral lifestyle.

Some of the main causes of conflict identified in the literature[33] are the following:

- Conflict over scarce or limited natural resources mentioned above;
- Cultural traditions, e.g. the glorification of warriors and of the killing of other ethnic group members;
- Historical relationships between groups, such as long-lasting conflicts leading to animosity and revenge. Consequently, ethnic groups make shifting alliances between groups according to power balances and strategies;
- Cross-border issues involving 3 countries in the Ilema triangle[34]: this territory is under Kenyan administration but is claimed by Sudan and Ethiopia. Local ethnic groups are trapped into a bigger transboundary power game and conflict;
- Dispossession and marginalization: local ethnic groups were traditionally oppressed or dispossessed of their natural resources by the central power through forced sedentarization, expulsion of their traditional territory and grazing lands[35]. The establishment of the Omo and Mago National parks and of large-scale commercial activities converting rangelands into agricultural activities[36] have placed the populations under great stress, creating or exacerbating conflicts;

[33] As for example Dr Yohannes Gebre Michael, Dr Kassaye Hadgu & Dr Zerihun Ambaye (2005), Addressing pastoralist conflict in Ethiopia. The case of the Kuraz and Hamer sub-districts of South Omo zone; Dr. Tafesse Mesfin (EPARDA), Pastoralism: the case of South Omo; EPARDA (2010), Peace Building in South Omo.

[34] Mburu, Nene (2003) "Delimitation of the Ilemi Triangle: A History of Abrogation of Responsibility." African Studies Quarterly 6, no. 4: [online] URL: http://web.africa.ufl.edu/asq/v7/v7i1a2.htm

[35] Drylands Coordination Group (2008), Pastoralists in Southern Ethiopia: Dispossession, Access to Resources and Dialogue with Policy Makers, DCG Report No. 53, October 2008

[36] Yemane, Beruk (2003) Food security situation in pastoral Ethiopia, Oxfam GB.

• Large supply of modern weapons traded by transboundary merchants, which increases violence;

• Dowry payments sometimes require large amounts of cattle, inducing people to organize raids.

Consequently, the ethnic groups present in the study area are regularly fighting each other, e.g. Hamar/Dasenech, Dasenech/Turkhana, Nyangatom/Karo, Nyangatom/Hamar, etc.

Since a few years, several initiatives have had effective and positive results, e.g. the EPaRDAs peace-building efforts and the South-Omo – Turkana Cross Border Conflict Mitigation Initiative in 2006.

Historical and Archaeological Sites

The historical defence walls of Ejajo Keela and Halala Keela are documented and the anticipated impact from submersion by the reservoir assessed. An observation has been made by the RAP consultant that a part (4-500 meters) of the Halala wall will be affected by the Chida-Sodo Road in its original alignment. The RAP December 2009 version does not, however, indicate whether the road realignment has remedied this potential impact.

Mitigation and compensation measures taken for the lost sections of the two walls include research and documentation of the walls as well as establishment of view points for each of the two walls for tourism purpose. A significant budget for these activities is allocated.

Discoveries of archaeological importance have been made in the Lower Omo and around present day Lake Turkana. One of the more significant finds includes remains of Homo sapiens at the location Omo Kibish-1. The exact location, however, is not described[37].

Other Development Projects

The RAP presents the NGOs active in the upper impact area, while the ESMP lists the few NGOs in the Lower Omo, i.e. Farm Africa, EPaRDA, Catholic Church and Refuges Trust. They cover the following sectors: health, education, water supply, livestock development, conflict resolution, food security, natural resources and agriculture. It would have been beneficial if an assessment was given for the downstream area as to which of the NGOs would have the capacity, experience and aspiration to collaborate with the Gibe III Project on implementation of the various livelihood activities.

[37] Wikipedia describes the location: "The Kibish outcrop is named after the nearby village of Kibish, the home village of the Nyangatom tribe. The village lies close to the east bank of the Omo River at the base of the Nkalabong Range". However, there are several villages with the name of Kibish in the Nyangatom area.

Chapter 5. EHS Management of Construction Sites

During the field visits on the 1st and 2nd of February, the ESIR Consultant carried out an EHS audit of the Gibe III construction sites. This audit included (i) a short presentation by the EPC Contractor's EHS Manager of the organization and activities, (ii) a review of the main documentation and (iii) a visit of the construction sites and facilities.

5.1 EPC Contractor EHS Management

EHS Reference Framework and Policy

The EPC Contractor Salini Costruttori and the Gibe III construction sites received official certification[38] OHSAS 18001:2007 (Occupational Health and Safety) on the 7 August 2009 (certificate N. IT09/0724) and ISO 14001:2004 (Environmental Management System) on the 11 January 2010 (certificate N. IT10/0004). In compliance with the obligations of the ISO 14001, Salini Costruttori released an Environmental Protection Policy in July 2009 signed by its Managing Director, Mr. Pietro Salini. The Environmental Protection Policy and the two certificates are provided in Appendix [8].

Organization

Organization of the EPC Contractor has been described in the previous Chapter of this report. It is worth noting here that the EHS Section staffs represent 35 persons including 3 expatriates.

5.2 EHS Provisions in EPC Contract

A number of EHS provisions are distributed in the contract documentation. The key documents are the EPC Contract Agreement (July 2006) and the Civil Works Technical Specifications (February 2009). Key clauses are the following:

EPC Contract Clause 6.4 (Labour Laws) impose to the Contractor the compliance with all applicable labour laws of Ethiopia, thus including the respect of the ILO Standards as Ethiopia has ratified all of the ILO fundamental conventions.

EPC Contract Clause 4.8 (Safety Procedures) defines the obligation for the Contractor to comply with all applicable safety regulations, to take care for the safety of all personnel, to use reasonable efforts to keep the site and works clear of unnecessary obstruction to avoid danger to persons, to provide fencing, lighting, guarding and to provide any temporary works (roadway, footway, guards and fences) to protect the occupiers and adjacent land.

EPC Contract Clause 4.18 (Protection of Environment) defines the obligation for the Contractor to develop an environmental management plan in order to cause minimum impact to the environment, to economize natural resources and energy, to take care of human health and safety. The Contractor is also responsible to train, inform and stimulate his staff towards participation and responsibility in environmental matters and to make sure subcontractors, supply and business partners implement high environmental standards. The Contractor's obligation is also to appoint an environmental inspector for the construction works, responsible for the guidance of the construction personnel on environmental matters and for communication with the employer (EEPCo). The measures for the protection of environment will be part of the project quality management plan and the contractor shall delineate the reservoir limit by providing delineation signs.

Clauses in the Civil Works Technical Specifications are related to Safety Program (2.1), Safety Standards (2.2), Personal Safety Equipment (2.3), Rescue Team (2.4), Maintenance of traffic and public road safety (2.5.3), Underground ventilation (2.6, air quality in tunnels), Storage and transport of explosives, blasting (2.7, 2.8), Fire prevention (2.9), Dust control (2.10), Prevention of surface water pollution (2.11), Noise control (2.12), Local communities and religious customs (2.13), Protection of vegetation and wildlife (2.14), Finding of archaeological, cultural resources (2.15), Sites/Camps installations applicable standards and services (4.1.1, 4.1.2, 4.3.1), Medical facilities (4.3.3), Power supply and lighting (4.3.7), Water supply (4.3.8), Sanitation and sewerage (4.3.9), Solid waste disposal (4.3.10), Fencing and site security (4.3.11), Site decommissioning and rehabilitation (4.3.12), Excavations, borrow areas and quarries (46.4.1, 6.4.3.5), Disposal of excavated material 6.4.7), Temporary roads drainage and maintenance (18.3, 18.4),

A detailed review of these provisions is provided in Appendix [9].

The ESIR Consultant considers that the typical HSE clauses in the contractual documentation satisfy good practice observed in international construction contracts.

[38] Certification delivered by SGS, an accredited certification organization from Milano, Italy.

5.3 EPC Contractor EHS Documentation

Health, Safety and Environment Plan

A HSE Plan was prepared by the EPC Contractor and issued in June 2007. A first revision was issued in October 2007. A second revision was issued in May 2009 in order to integrate the results of the Head Office Audit of April 2009, and a third revision dated November 2009 provides an update of the appendices and of the Company HSE Policy.

The HSE Plan structure includes 19 sections presented in Appendix [10] of this report and further 11 Appendices detailing components of the Plan, listed below:

1. Roles & Responsibilities
2. Training Plan
3. Documents & Data Control
4. Control of Records
5. Emergency Response Plan
6. Hazard/Effects Register
7. Identification of Significant Environmental Aspects
8. Environmental Aspects/Effects Register
9. Objectives & Targets
10. HSE Key Performance Indicator
11. Management Review

These various elements are compliant with the requirements of ISO14001 and OHSAS 18001.

HSE Procedures

The EPC Contractor has already issued a number of HSE Operational Procedures which are listed in the following Table.

Table [15] - List of HSE Procedures

Reference	Date of Issuance	Procedure Title
SF PR 002 01 A EN	24/10/08	Safe Driving Procedure
SF PR 004 01 A EN	31/10/08	Explosive Material Management Procedure
SE PR 013 01 A EN	22/12/08	Signs & Marking
EN PR 017 01 A EN	29/12/08	Emission & Dust Management Plan
EN PR 019 01 A EN	20/08/09	Erosion & Sediment Control Plan
EN PR 015 01 D EN	29/10/09	Waste Management Plan
EN PR 016 01 C EN	29/10/09	Water Management Plan
EN PR 020 01 A EN	10/11/09	Landscape Rehabilitation
EN PR 018 01 D EN	23/11/09	Spill Prevention, Control & Countermeasure Plan
EN PR 012 01 C EN	27/11/09	PPE Distribution & Compliance

The recruitment of personnel is performed in accordance with the Ethiopian regulations and in the strict respect of the ILO Principles. It is also worth to mention that the workers have organized a Union on site and the EPC Contractor has provided a dedicated building to satisfy the needs for Union activities.

The review of the EPC Contract clauses (see Appendix 9) and of the E&S documentation of the EPC Contractor leads the ESIR Consultant to the conclusion that these documents are compliant with the international good practice and do not require any significant improvement or complementation.

5.4 Review of E&S Acceptability of Existing Works

General

Construction sites were visited on February 1st and 2nd by the ESIR Consultant accompanied by the HSE Site Manager of the EPC Contractor. The visit included construction sites, workshops, quarries, camps and canteens.

Solid Waste

Non hazardous solid waste receives various treatments depending on the origin of the waste.

Domestic

Domestic waste is produced all over the sites, but in higher quantities in the residential areas and canteens. Waste is mainly organic, with plastics and paper packaging. Domestic waste is collected daily using an Isuzu truck operated by the HSE Division. Plastic bottles and other plastics are separated before the waste is disposed at the central landfill.

The landfill has been recently constructed in a remote area, far from any drainage network and from underground water. It follows a classical design (see pictures), the bottom covered by a compacted clay layer. It is fully fenced and a watchman lives on site.

The waste is regularly covered by soil to avoid the development of flies. The waste is regularly compacted by a bulldozer coming from a quarry located next to the landfill.

Construction Waste

Construction waste is segregated at source on the construction site and disposed of in dedicated areas next to the main workshop. Plastics, wood and scrap metal constitute most of the waste. Scrap metal is regularly sold to recycling companies which collect it from the site. Tires are also stored and regularly collected by a company which process the tires and recycles them as substitute fuel. Recycled quantities of waste are registered and reported in the monthly HSE Report. For the period October to December 2009, 35.6 t of scrap metal and 69.87 t of tires were collected for recycling.

Plastics (1.16 tons) and rubber waste (2.0 tons) have been disposed of in the landfill during the same period. No recycling company for plastic has yet been identified in Ethiopia.

Medical Waste

Non-contaminated waste (packaging, food waste) is collected and treated as domestic waste. Contaminated medical waste is incinerated at the clinic site, each of the 3 clinics being equipped with an incinerator (see picture).

Hazardous Materials & Hazardous Waste

HazMat Register

Hazardous materials and waste (called Hazmat) produced are quantified and entered into a register. Data from the register is provided in the monthly HSE report of the EPC Contractor. For example, during the last quarter of 2009, 3.18 tons of waste concrete additives and 11,420 liters of used oil/grease were produced.

HazMat Storage

Hazmat is stored depending on the product type. Diesel, oil drums (new or used), concrete additives are conventionally stored in dedicated areas consisting of a concrete slab, fully bunded providing a retention capacity of at least 110% of the largest container stored, in compliance with good practices. These storage areas are roofed, with a drainage outlet equipped with oil separator.

Portable retention facilities in metal, suitable for up to 4 drums are available in the workshops (see picture).

Waste containers of paint, solvent and used oil filters are stored in a storehouse with concrete slab. Used batteries are stored in a 20 ft locked container.

HazMat Safety Instructions

Hazmat safety sheets are available for consultation in the workshop (see picture). The sheets are accompanied by the emergency procedure including telephone numbers of persons to call.

Recycling of Used Oil & Grease

Used oil and grease are produced in large quantities during earthworks and civil works activities. The products are carefully stored in drums and collected by a recycling company[39] from Addis Ababa certified by the EPA. Certification letter from EPA is provided in Appendix [4].

Management of liquid Effluents

Management of liquid effluent is organized in a way which avoids direct discharge into a stream or into the Omo River. This has been facilitated by the distance between the main sources of effluent and the Omo River.

Effluents from Workshops Areas

Effluents from workshop areas and the truck washing platform are directed to sedimentation ponds from where oily products are skimmed off and disposed into a container for recycling, and from where the remaining effluent is settled, aerated and passed through a sand filter before being discharged on land (see pictures).

Effluents from Batching Plants & Acetylene Plant

Effluent from batching plants are directed to sedimentation ponds and then to sand filters and to a bioremediation plot (planted vegetation absorbing the effluent). Remaining effluent is applied to land. Effluent from the acetylene plant follows the same treatment process (see pictures).

[39] Habitable Business Solution PLC

Water from truck cleaning & maintenance areas is collected and treated: oil separation by skimming, sedimentation then….

aeration before being transferred….

to a sand filter before discharge on the land

All maintenance areas are equipped with similar waste water treatment systems.

Waste water from the acetylene plant is collected…

and treated through sedimentation, sand filtration and eventually bioremediation (planted vegetation)

Sedimentation ponds for batching plants waste water

Sedimentation ponds for waste water from gravel cleaning operation. Sludge is being removed from the pond. The effluent water is discharged into a channel….

which supplies water to irrigated gardens developed by the local communities along the Omo terraces, or….

discharged in a slight depression where a new wetland has developed attracting birds.

Fuel storage area with full concrete slab and bunds

Fully bunded storage area for hazardous materials (oil and grease, Sika products etc)

Mobile storage device for hazardous materials

HSE information panel in the main workshop, including emergency procedures and safety sheets for all products available

Safety instructions and equipment box in the workshop

which is particularly well maintained and cleaned

Use of absorbent material on oil spilled on the concrete ground

Safe handling of acetylene bottles

Effluents from Crushing plant & Material Washing

This effluent, with a particularly high sediment load is discharged into a large sedimentation pond. Resulting effluent is directed towards a small banana plantation and gardens developed by the local residents for irrigation. Excess water is discharged in a slight depression where it allows the development of wetland conditions attracting birds (see pictures).

Worker Accommodation

Camps Facilities

Accommodation

Two worker camps are presently operational, the right bank camp, the largest one and the left bank camp, which should be more temporary. Accommodation is provided in one floor buildings of 8 rooms with 1 to 4 beds. Each room is equipped with glass windows, each bed is equipped with a mattress and impregnated mosquito net.

Showers & Toilets

Every two accommodation buildings are served by a sanitary block including 5 toilets, 9 showers and 6 washbasins located on the outside, each with 2 taps. It means that the ratio is about 13 workers per toilet, a rather good ratio if compared to the standard of maximum 20 persons/toilet.

Catering

In each worker camp, a canteen provides meals for the workers. Catering has been subcontracted to a national company, but the EPC Contractor HSE staff performs a strict monitoring regarding hygiene of the canteen workers, meat processing, food conservation and water quality.

Recreation

The right bank camp provides recreation facilities: satellite TV (2 sets installed in the canteen), snooker, and a fully lit football ground .

Religion

The right bank worker camp includes a protestant church, an orthodox church and a mosque.

Water Supply

Water is pumped into the Omo alluvial aquifer (through a group of pumps located on the right bank, just downstream from the new bridge.From there, the water is pumped up to the EPC Contractor Offices and workshop area, where the water is discharged in a large concrete reservoir.

From here, water is pumped to the water treatment plants (one in the Office area and one in the worker camp) which include the full treatment process with flocculation (with alum), filtration and chlorination. A similar treatment plant is located in the EPC Contractor Camp to supply this camp and the EEPCo camp located nearby.

Water quality is controlled once a month for the presence of Coliforms.

Sanitation

All the sanitation facilities in the camps and working sites consist of septic tanks. The EPC Contractor has contracted a company Sodo which provides a pumping truck whenever some tanks need sludge removal. No resurgence of effluence has been observed during the site visit. The Employers Permanent Camp, of which construction should start soon along the new Gibe III to Sodo road, will be equipped with a waste water treatment plant.

Dustbins of specific colors corresponding to dedicated types of solid waste

Solid waste collection truck in a worker camp

Central landfill for domestic solid waste. The bottom is covered by a compacted layer of clay.

Scrap metal is temporary stored before removal by a recycling company.

Plastic bottles are temporarily stored on site until a recycling company is identified in Addis Ababa

Similar situation for plastics

Storage of contaminated waste: oil drums, oil filters

and containers of other chemicals such as paints)

Closed container for the disposal….

….of used car batteries

Environmental Awareness training for all recruited workers….

And specific training on environmental management and safety for workers in charge of specialized jobs.

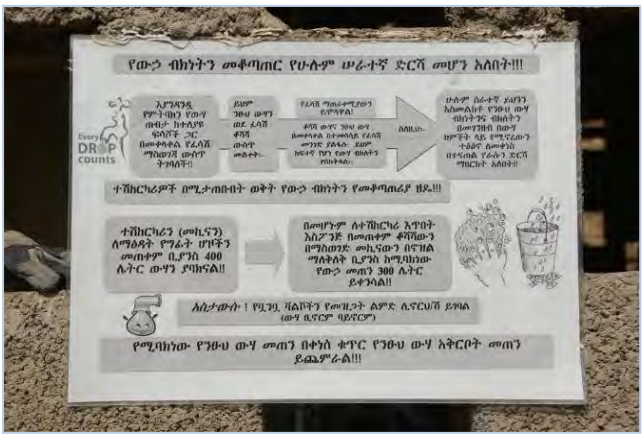
Pumping field for water supply of the camps & facilities located along the Omo River next to the new bridge (in the background)

Water is pumped from a 20 to 25 m depth in the rivers alluvial aquifer

Water is pumped up into a raw water storage tank next to the Contractor's Offices from where it is pumped to the various camps

Next to the storage, a treatment plant supplies potable water to the Offices area

Each camp is equipped with a water supply treatment plant including flocculation (Aluminium sulfate) , filtration and chlorination



Information supporting a water saving campaign is posted at public places (shower rooms, canteens, offices

Traffic Safety

The several access roads developed for the implementation of the construction sites and the camps are all equipped with drainage and safety signs. Awareness training is also delivered to the drivers. Trucks and light vehicles are also well maintained on site. The HSE staff is equipped with a portable radar to control speed of the vehicles.

Watering trucks are observed along the non-surfaced roads where dust is a problem and may create locally unsafe driving conditions.

In the near future, when the construction of the RCC dam starts, the transport of cement will increase the traffic safety risk. Indeed, the concrete will require 570,000 tons of cement from the Mugher Cement Factory. With cement trucks having only 32 tons capacity, it will involve almost 18,000 trips of 1,100 km each.

Health Management

Facilities & Staff

The Project site is equipped with 3 clinics (one at each worker camp and one at the EPC Contractor camp), and 2 First Aid posts (one at Powerhouse site and one at the EPC Contractor Office site). Each clinic is staffed by a doctor and 3 nurses, and each first aid post by one nurse.

By the time of the site visit by the ESIR Consultant, the total health staff included: 3 doctors, 11 nurses, 1 health assistant, 1 sanitary engineer, and 1 laboratory assistant.

Each clinic includes a drugstore, office, patient rooms, examination room, laboratory and one room equipped for small surgery. One ambulance is attached to each clinic, and the Project has two additional stand-by ambulances. Each worker receives a medical check-up at recruitment and the files are archived at the clinics. The clinics are also open to local villagers in case of emergency.

HIV/AIDS Prevention

A specific prevention program has been implemented by the HSE Department of the EPC Contractor. The program is based on the distribution of brochures and posters, on awareness training and information meetings. The HSE Department collaborates on this program with a local NGO (World Learning Ethiopia), which assists with education and training activities.

The HSE Department has also implemented distribution of free condoms in the canteens and in other places in the worker camps.

Three clinics (EPC Contractor camp, 2 worker camps) and 2 first aid posts (Offices and Power House) have been built (Picture: right bank worker camp clinic)

The examination room and the doctor in charge

One of the 5 ambulances available on site

Each clinic is equipped with an incinerator for contaminated medical waste

View of the left bank worker camp

Right Bank Worker Camp

Worker rooms are equipped with impregnated mosquito nets

Coordination with local police for public safety issues. In the foreground is a box for free distribution of condoms as a component of the HIV/AID campaign

One sanitary block per every 2 buildings of 8 rooms each. Each block includes 6 washbasins (24 taps), 9 showers and 5 toilets

Washbasins at the entrance of the canteen

Right bank worker camp canteen store….

and catering management office

View of a canteen including satellite TV facilities and…

…snooker (left)

Butchery section of the canteen

Kitchen area with food ready for distribution

Free condom box in the canteen

Health & safety poster on the canteen wall; notice the Canteen Hygiene Weekly Checklist in the middle and poster for hand washing

Football field in the right bank worker camp

Watering of roads to reduce dust

Basalt Quarry No.2 ready for closure. Rehabilitation will involve smoothing slopes, top soil application and revegetation

Lower part of Basalt Quarry No.2 where a weir has been built to avoid the transport of sediments from the site during the rainy season

Rehabilitation of a former camp area. Covering with top soil and plantation of trees (Cassia, Grevilea, Azadirachta)

Grevilea plant

Awareness Training

The HSE Department has engaged permanent awareness training activities in accordance with its HSE Plan. Activities are reported in HSE Monthly Report. The last report for December lists the following training sessions performed during the month:

- Introduction to HSE for Gibe III (26 participants)
- Light vehicle & truck driver safety (7 participants)
- Heavy machinery operators safety (5 participants)
- Fire fighting & prevention (19 participants)
- Induction to new explosive products (6 participants– external training)
- Operational instruction for diesel handling (11 participants)

• HSE organization & control plan implementation (11 participants)

• Site map for HSE staff (8 participants).

Spontaneous Settlements

Due to its remoteness, the Gibe III project didn't suffer unduly from spontaneous population influx. Indeed, during the site visit, only 3 temporary huts were noticed in the vicinity of the camps, using the surrounding areas for sheep grazing.

According to the HSE Site Manager, two of these huts are already located within the right of way of the new Chida-Sodo road and will be displaced as soon as the work starts.

Spontaneous population has never been, is not and should not be an issue for the Gibe III Project during its construction.

One spontaneously erected hut close to the left bank worker camp

The 2 other spontaneous huts on the right bank will be removed when the Chida-Sodo road works start

Site Rehabilitation

Site rehabilitation is an objective of the HSE Plan. The HSE staff has already started trials for revegetation, particularly on the Mela plateau (near the Salini Airport) where a temporary camp was recently decommissioned. All structures were removed, top soil spread over the gravel surfaces and tree plantation carried out using species produced by the forestry department: *Leucaena, Grevilea* and *Azadirachta* (neem). Plantation was performed in May 2009, and results observed were rather encouraging regarding growth and survival rate.

The old clay quarry located on the same plateau a few km after the airport will be the next area to be rehabilitated in 2010. According to the results of the revegetation trials, the HSE Department will develop a nursery facility to satisfy its requirements.

Auditing

In compliance with the ISO14001, the HSE is audited once a year by the EPC Contractor Management. This audit complements the monthly audit performed by the Independent Inspector and the semi-annual audit by the E&S Impact Specialist.

5.5 Conclusions

The construction sites are well managed by a dedicated HSE staff, in accordance with the terms of the HSE Plan and in compliance with the EPC Contractor's HSE contractual obligations. Sites are generally clean, well organized and safety measures reasonably implemented. This reflects positive results from HSE awareness training activities among staff and workers.

The HSE Plan and attached documentation are compliant with the principles of OHSAS 18001 and ISO14001, which is also confirmed by the certifications obtained in 2009.

The ESIR Consultant considers that HSE issues are correctly managed on the Gibe III project area and these issues should not represent a risk in the future for potential lenders if the present level of management is maintained.

Chapter 6. Review of Criticisms from Civil Society Organizations

The Gibe III Project has been strongly criticized by some of the civil society organizations. In this Chapter, the ESIR Consultant is reviewing systematically the criticisms expressed and provides comments. The major environmental and social issues raised in the criticisms are then addressed in detail in the following sections of this Chapter.

6.1 Review of Key E&S Issues Raised

The following Table aggregates the key criticisms expressed by the NGOs. For clarity purpose, the review is presented by issue with a comment from the ESIR Consultant reflecting analysis.

The documents listed below provided the basis for this review. They constitute the major documents, whereas others are reflecting views and opinions prepared by the formers.

- Africa Resources Working Group (ARWG): A Commentary on the Environmental, Socioeconomic and Human Rights Impacts of the Proposed Gibe III Dam in the Lower Omo River Basin of Ethiopia; January 2009.
- Campagna per la Riforma della Banca Mondiale, Les Amis de la Terre and International Rivers (CRBM, LAT & IR): NGO letter re. Gibe III Dam to J.P. Morgan Chase; January 14, 2008.
- Campagna per la Riforma della Banca Mondiale and bankwatch network (CRBM & BN): The Gilgel Gibe Affair – An analysis of the Gilgel Gibe Hydroelectric projects in Ethiopia; 2008.
- International Rivers (IR/1): What Cost Ethiopia's Dam Boom? February 2008.
- International Rivers (IR/2): Facing Gibe III Dam: Indigenous Communities of Ethiopia's Lower Omo Valley; January 26, 2009.
- International Rivers (IR/3): Ethiopia's Gibe III Dam: Sowing Hunger and Conflict; May 2009.
- Friends of Lake Turkana (FLT): Kenyan Request for Investigation of AfDB and Gibe III Dam; February 5, 2009.
- Solidarity Movement for a New Ethiopia, Bank Information Center, Campagna per la Riforma della Banca Mondiale, Indigenous Peoples of Africa Coordinating Committee and International Rivers (SMNE, CRBM, IPACC & IR): Request for CRMU Compliance Review and Investigation of the Bank's Gibe III dam Project to AfDB; April 22, 2009.
- Survival International (SI/1): Letter to AfDB re. Gibe III HEP; April 9, 2009.
- Survival International (SI/2): Letter to AfDB re. Gibe III HEP; August 18, 2009.

It is worth mentioning that if all documents elaborate on environmental and social issues, the ARWG report was the most detailed regarding the environmental issues, most of the other documents relying on the arguments developed by ARWG. The reason is probably that the ARWG carried out a first review of Gibe III based on the ESIA issued in 2006 in which most of its arguments were developed. The second report of January 2009 (analyzed below) is only an update of the first report including a review of the downstream ESIA of 2008. So, many organizations rely on the information provided by the ARWG (including some TV Channels) to built their criticisms, and apparently didn't question any of the figures provided in the ARWG.

Table [16] - Review of Criticisms from Civil Society Organizations

No.	Issue raised	Raised by	ESIR Comments
1	Estimate of up to 10-12 m drop of Lake Turkana level after impoundment	ARWG	Incorrect figure possibly based on a wrong estimate of reservoir capacity. ESIR Consultant estimates a maximum drop around 1.5 to 2 m
2	Possible 50-75% leakage of water from the reservoir, with only portion of the water *ever* re-entering the Omo River system	ARWG	Statements without scientific evidence: Technical studies consider 11% of infiltration during impoundment. After, leakage is marginal. Omo River system is the *lowest* drainage in the region. All water infiltrated will eventually move towards Lake Turkana.
3	Risk of seismic activity with possibility of major event	ARWG	Risk cannot be avoided. Studies have been performed in accordance with international standards. Dam breach study should be performed in compliance with WB Dam Safety OP.

No.	Issue raised	Raised by	ESIR Comments
4	Major transboundary issues (Ethiopia, Kenya, Sudan)	ARWG	This catastrophe-type scenario is built on a wrong estimate of river flows and volumes. The size of the delta is highly fluctuating even under natural conditions and the future situation should not be much different from what is observed since 30 years
5	Elimination of the riverine forest due to at least 57 to 60% reduction in river flow volume	ARWG	Incorrect. The riverine forest along the downstream Omo River should benefit from the higher and more stable alluvial aquifer level. The percentage in flow reduction presented in this statement is not supported by any scientific evidence.
6	Gibe III will lead to cessation of all recession cultivation	ARWG	This statement is probably excessive, but most of the recession agriculture may disappear if no mitigation is provided. Controlled flooding is proposed in the ESIA-DS to sustain recession agriculture. An analysis of the potential efficiency of this measure is carried out by the ESIR Consultant.
7	At least 200,000 indigenous people are heavily dependent on Omo River for survival.	ARWG	The ESIR Consultant estimates that maximum 84,200 people are directly dependent on the river, to various extents.
8	Increase in Lake Turkana salinity because of the decreased flow from Omo	ARWG	This impact is based on the flow reduction figures discussed above. On the basis of a much more limited reduction of water inflow to lake Turkana, such impact is not considered as significant by the ESIR Consultant. Additional investigations on the subject are recommended.
9	Loss of access to livestock watering places along Omo River	ARWG	Not mentioned as an impact in the ESIA-DS but compensation measures suggested (pp. 186 and Appendix 4).
10	Proposed controlled floods has never been effective in other similar projects of sub-Saharan Africa	ARWG	There is obviously a risk of conflicting interest which leads to the reduction or suspension of artificial flooding. Proposals for alternative downstream water management solutions are identified in the present report.
11	"ARWG calculations (…) indicate the reservoir capacity might be reached within few years" (about sedimentation in the reservoir)	ARWG	Unfortunately, the ARWG calculations are not described. The sedimentation report, confirmed by the EFTA study, concludes that the sediment will not affect the live capacity of the reservoir before 130 years, far beyond the life duration of the project.
12	Gibe III would cause major reduction of sediment and nutrient replenishment in the downstream area	ARWG	True. However, the river runs 200 km before the first villages and river bank recession agriculture, and further 400 km of plain before reaching the last stretch of 150 km to the delta. The river bed will most probably reach a new equilibrium before the delta area. Additional investigations on the subject recommended by the ESIR Consultant.
13	The riverine forest would be eliminated, because 57 to 60% drop in downstream Omo flow At least 290 km² of riverine forest and riparian closed canopy woodland will be destroyed	ARWG	Drop in flow indicated is not justified as previously discussed. On the basis of what is known at present, the downstream Omo flow will decrease during the first impoundment, and will not be affected significantly during operation in average. However, higher stabilized flow will increase water availability in the alluvial aquifer and improve water supply of the alluvial forest vegetation
14	Inadequate consultation process	ARWG; CRBM, LAT & IR; CRBM & BN; IR/2; FLT; SMNE, CRBM, IPACC & IR; SI/2	Consultation process in downstream area is incomplete as consultation was carried out in selected kebeles only. Lower level government officers have not always given a balanced picture of potential impacts. A more thorough consultation process is needed: on impacts and policy, concerns and suggestions, on proposed mitigation measures. In areas affected by reservoir and Chida-Sodo Road, the process has been implemented better, although not all communities have been covered – only the kebele administration – and documentation of women taking part is lacking.

No.	Issue raised	Raised by	ESIR Comments
15	Impacts on grazing land for 275 nomadic households not addressed	CRBM, LAT & IR; CRBM & BN	Loss of grazing land in the future reservoir area is marginal (small proportion of each household's total livelihood income) and resource is communal. Hence, compensation will be made in terms of improved livestock forage in all affected woredas. In addition, a bridge and nine river crossings (boat service) will be established, for cattle and people.
16	Malaria and bilharzias vectors will develop at reservoir site	CRBM & BN	RAP is addressing this issue (p. 129-30). The ESIR Consultant is sceptical towards the potential extent of the problem considering the type of habitats created, but supports monitoring measures linked to a mitigation plan.
17	Lack of archaeological plan	CRBM & BN	A Chance-Find procedure is established at dam site with the EPC Contractor. In downstream area, no negative impact is envisaged on potential archaeological sites.
18	Compensation level is inadequate	CRBM & BN	Compensation rates are based on national regulations (see RAP, table 8.2) and market values.
19	The ESIA is largely based on insufficient scientific analysis and a lack of evidence. It quickly concludes that numerous impacts, including to local communities and protected areas, are negligible. Risks to health and livelihoods of affected communities are particularly poorly addressed. Mitigation measures are inadequate, unrealistic and do not acknowledge the failure of similar mitigation measures at other dams in Ethiopia.	IR/1; IR/2	Criticism expressed here is very general and is not based on facts. ESIA-DS lacks detailed baseline data and an understanding of the feasibility of various compensation measures suggested.
20	Researchers find that communities in the Lower Omo seldom benefit from food aid and are more self-sufficient than in other arid regions of Ethiopia	IR/2	The statement is correct, and largest part of the food aid to Ethiopia is supplied to other regions. Some dependency on food aid (usually Food-for-Work) has been observed in all areas visited by the ESIR Consultant but often only 1-2 months per year.
21	Serious impact on crop production, grazing lands and fishing", but proposed mitigation measures do not address these grave risks.	IR/2	If not mitigated there will be negative impacts on recession farming and pasture lands. However, positive benefits for fishing are anticipated. Mitigation measures require feasibility studies.
22	A truncated 10 day flood would not reach all the areas now nurtured by annual flooding.	IR/3	The 10 day flood will probably satisfy the flooding of the river banks, but may not be sufficient to inundate the flood plain. Additional hydrological investigations are required to clarify all the issues linked to the change in river hydrology and the proposed controlled flood.
23	Lack of impact studies on Lake Turkana.	FLT	True. The ESIA documentation doesn't address Lake Turkana issues. Preliminary analysis is provided in the ESIR Report.
24	No analysis regarding potential changes to the river flow, volume, and chemical balance.	FLT	Changes in river flows have been addressed in a preliminary form in the ESIA-DS. More is required to better understand downstream and delta implications
25	No details on impoundment procedure.	FLT	Correct. Impoundment procedure was only presented in a workshop on 3rd June 2009. The procedure is analyzed by the ESIR Consultant
26	Unaddressed violation of domestic law in project preparation.	SMNE, CRBM, IPACC & IR	Correct. Construction started in 2006 while approval of ESIA by EPA was notified in July 2008.

No.	Issue raised	Raised by	ESIR Comments
27	Poor and inaccurate baseline information	SMNE, CRBM, IPACC & IR	Agree on issues mentioned for downstream area and for slope stability in the reservoir area.
28	Inadequate consideration of project alternatives	SMNE, CRBM, IPACC & IR	Analysis of alternatives is insufficient but choice for the project is already made. Alternatives should now focus on water management, design improvement/optimization
29	Unsuitable mitigation measures leaves hundreds of thousands at risk of diminished quality of life and livelihoods	SMNE, CRBM, IPACC & IR	Mitigation measures suggested need further study and refinement. Adequacy of controlled flood in present form appears questionable.
30	Grave risks for indigenous communities in South-western Ethiopia	SMNE, CRBM, IPACC & IR	Agree on the serious risks, directly for approx. 84,200 people. But proposed measures, if appropriately implemented, may significantly reduce the risks.
31	What protection will be offered to downstream communities?	SI/2	Livelihood improvement and social development plan are outlined in the ESIA-DS. This plan will be further developed through feasibility studies and adequate consultations. A problem is that the ESIA-DS sees these measures as being responsibility of GOE / EEPCO. The controlled flood is by the ESIA-DS authors seen as sufficient to address negative project impacts.

6.2 Conclusions of the ESIR Consultant

The first and main document on the potential impacts of the Gibe III project is the first report from ARWG (2007) and its up-date issued in January 2009.

Most of the other documents, at least regarding environmental issues, rely on the ARWG figures and criticisms. Unfortunately, some of the key issues raised by the ARWG are based on assessments and computations for the least questionable: the 50-75% reduction of the river flow in the downstream area, the 10-12 m drop of the Lake Turkana have, with a reason, resulted in a strong reaction of the international community and the release of several documents and even TV documentaries based on these figures. The ESIR Consultant found these forecast strongly exaggerated, and not supported by any tangible scientific evidence. A similar analysis of these impacts is developed in the following pages of this report, which comes to more moderate results.

Many documents claim that the baseline information provided by the ESIA documentation both for the upstream and downstream areas is insufficient. The ESIR Consultant share this opinion, and has tried, as far as possible, to complement the baseline information presented in the chapter "Baseline Situation".

All documents have also commented on the inadequate consultation process, especially in the downstream area. The ESIR Consultant agrees with the main message. Consultations need to be improved in coverage and quality.

Chapter 7. Major Environmental Issues: Impacts & Mitigation

7.1 Impacts from Chida-Sodo Road and Transmission Lines

Impacts from road realignment and TL are limited. The road corridor crosses mainly areas intensively cultivated and areas of open broadleaved deciduous woodland, characterized by *Combretum sp.* and *Terminalia sp.*, strongly disturbed by frequent fires, grazing and wood collection. The ESIA reports only 33 woody species observed on the field, a low figures which results probably from human pressure. Occasional stretches of alluvial forest, in better conditions (more water, less fire), will be affected at the crossing points between the road and small tributaries. The total Right of Way (RoW) represents an area of 150 ha, of which only 2% concerns alluvial forest.

The ESIA did not identify particular wildlife resource in this densely populated area which is not commonly observed around the road corridor..

The 65 km transmission line (186 towers for an average span of 350 m) will also have limited impacts on the natural environment. Most of the 25 ha of natural clear bush concerned by the RoW will not need clearing, being of limited height, and mainly a total of 25 ha of small eucalyptus plantation will be affected. Due to the present level of agriculture development along the TL route, no significant impact on wildlife is anticipated. The new substation at Lasho Kebele will only affect 2.5 ha of grazing land. According to the ESIA study, no bird migration corridor is reported along the TL route or in its immediate vicinity.

No protected area is reported contiguous to or in the vicinity of the road and the TL corridors. These two facilities do not result in significant environmental impacts, being implemented in an already transformed environment, with extensive rainfed agriculture and urbanized areas. Major impacts are social, related to land acquisition, compensation and resettlement, presented in the next Chapter of this report.

Most environmental impacts may arise during construction, particularly for the road, with risks regarding erosion, drainage, sediment transport and slope stability. These issues are addressed in the EMP and what is reflected on site by the roads already constructed lets anticipate the EPC Contractor to implement good construction practices and to mitigate appropriately these potential impacts.

7.2 Issues from Reservoir Creation

Reservoir Characteristics

The main characteristics of the reservoir are provided in the following table. These figures raise a few remarks:

- The reservoir capacity is equivalent to the average annual runoff of the controlled watershed; it could be filled within one average year of inflow;
- The seasonal drawdown is about 40 m, but the exceptional maximum drawdown is 92 m, which may result in an extensive maximum drawdown area of 143 km²;
- The length of the reservoir at mOL is about half of its length at MOL.

Table [17] - Main Characteristics of the Gibe III Reservoir

Parameter	Unit	Value
Extreme flood Level (PMF level)	m asl	892.5
Maximum Operation Level (MOL)	m asl	892.0
Minimum Operation Level (mOL)	m asl	854.0
Exceptional mOL	m asl	800.0
Average Operation Level (AOL)	m asl	875.0
Total Storage Volume (at MOL)	Million cu. m	14,700.0
Storage at mOL (dead storage)	Million cu. m	2,945.0
Active Storage	Million cu. m	11,755.0
Total storage at AOL	Million cu. m	11,950.0
Area at MOL	Km²	209

Parameter	Unit	Value
Area at exceptional mOL	Km²	66
Maximum Drawdown Area	Km²	143
Perimeter at MOL	Km	435
Perimeter at mOL	Km	200
Reservoir length at MOL	Km	150
Reservoir length at mOL	Km	80
Average Annual Runoff	Million cu. m	13,820
Maximum Depth	m	240
Average depth	m	70
Average Annual Runoff	m^3/s	438.2
Water retention time	Year	1.06

Impacts on Vegetation & Wildlife

The flooding of the reservoir will have minimum direct impacts on land cover and communities. According to the ESIA, the land cover in the future reservoir area consists of 18.4 km² of riverine forest and 171.6 km² of deciduous woodland, the remaining part being bare ground and water bodies (part of Omo River and tributaries flooded). **There are no permanent settlements or cropland within the future reservoir area.**

A significant part of the terrestrial wildlife is located in the alluvial forest, particularly during the dry season for access to water and some green foliage. As discussed further below, the impoundment of the reservoir is anticipated to start on a 1st May and according to the simulations performed by the EPC Contractor, the water will raise by 30m in May, 40m in June and 50m in July, or a water raise ranging from 1.0 to 1.7 m/day. Due to the shape of the valley, the flooding process will not create many islands where animals may take refuge and eventually drown.

The ESIA proposes to set up wildlife rescue teams during the impoundment period to collect animals trapped by water. Due to the great length and the narrow shape of the reservoir, the ESIR Consultant considers that this approach may require too many staff and boats to be efficient and that there is a risk for the teams because of the speed of the flow in case of flood occurrence. A more recommendable approach would be to have the wildlife removed before the start of the impoundment. The best ways would be to perform a pre-impoundment clearing of the riverine forest as described below. During the clearing, animals will be pushed out of the area and will eventually settle either upstream or downstream of the project zone.

Impacts on Water Quality

As the reservoir area becomes flooded after dam closure, several processes occur which have a dramatic effect on the impounded water quality. Plants, starved of atmospheric oxygen, die and start to decompose. When combined with the decomposition of the organic matter from the top soil, the dissolved oxygen of the reservoir water depletes quickly, resulting in anaerobic conditions at the bottom of the reservoir.

Aerobic decomposition of biomass absorbs quickly all the oxygen of the water and releases carbon dioxide (CO_2). Anaerobic decomposition releases mainly methane gas (CH4). This phenomenon has key impacts on water quality and eventually on greenhouse gas (GHG) production, only superficially addressed in the ESIA.

In deep reservoirs, the water column is stratified: (i) the superficial layer (epilimnion), oxygenated, of good quality water, where life develops (plankton, algae, fishes etc), and (ii) the rest of the reservoir (hypolimnion) consisting of cold, deoxygenated and acidic water, enriched in methane (CH_4) and hydrogen sulfate (H_2S) gases, generally devoid of life except anaerobic bacteria. The stratification is generally thermal and happens at 10 to 30m depth depending on several criteria (reservoir shape, water and atmospheric temperatures, etc.).

The two inlets for the power tunnels are located at 780m, or 110m below the MOL (892m) and 95m below the average operation level. The turbined water will definitely be abstracted from below the thermocline and will discharge low quality water, particularly the first few years after the first impoundment, when most of the flooded organic matter is decaying. The release downstream of such anoxic and methane-full water is highly detrimental to aquatic biodiversity and affects local communities using the river for domestic or cattle water supply.

In Gibe III, this detrimental impact is strongly mitigated by the fact that the river flows along almost 200 km of non-inhabited valley; also, water is not released on a permanent basis but with high discharges on part-time basis, which favours turbulence of the flow and the quick release of the methane and H2S gases. **It is most probable that the water has recovered its quality** (released of all CH4 and H2S and at least 5 mg/l of dissolved oxygen[40]) **after 10 or 20 km**.

Along this first stretch of river, aquatic biodiversity will be affected. Fish will move further downstream, until the dissolved oxygen recovers acceptable limits, and most of the benthic fauna (insect larvae, worms) will disappear.

[40] 5 mg/l of dissolved oxygen is a minimum level above which most of the fish fauna of the river will survive and keep its biological development

However, the fist stretch of river will mainly be affected by the hydraulic impact of turbine operation[41], and in this stretch, water quality issue should not add much to the anticipated conditions.

The two middle outlets (for the controlled flood operations) are located even lower (750 masl), and will also release anoxic water. However, water will be discharged from the middle of the dam, at about 80m from the river bed. Maximum turbulence and air-water contact during the discharge will favour the release of most of the dissolved methane gas and favour dissolved oxygen in the water. **The full recovery of the controlled flood water will probably be achieved over a shorter distance than for turbined water**.

Reservoir Clearance Issue

Possible Strategies

According to the ESIA, it seems the Project will carry out a pre-impoundment clearing of the reservoir. However, information on how and when this task will be performed is not provided in the report.

Considering the size of the reservoir (209 km²), the full clearing is not under consideration as the task will be too long, too costly and needs to be justified in terms of benefits. Also, pre-impoundment clearing has not only advantages. Major anticipated advantages and disadvantages of pre-impoundment clearing are presented in the Table [18], in accordance with 4 pre-impoundment clearing strategies: 1) Do nothing, 2) Cut trees without removal, 3) Cut trees and remove, 4) Cut trees and burn.

The best strategy for Gibe III is most likely a combination of some of the above strategic options. The objectives of the pre-impoundment clearing could be defined as follows:

- To minimize adverse impacts of high initial oxygen demand through reduction of the vegetal biomass;
- To control nutrient concentrations and risk of eutrophication during initial filling;
- To promote reservoir fisheries and navigation;
- To create suitable areas for fish development;
- To maximize collection of valuable timber;
- To preserve shoreline soil stability;
- To optimize benefits from clearing.

Recommended Strategy and Methods

As presented in a specific section on GHG emission, the soft biomass (leaves, fruits etc.) is the first material to decay after filling and which absorbs large quantities of dissolved oxygen. To reduce intensity and duration of water quality alteration, clearing operation should first focus on the riverine forest, which shows the highest soft biomass density and the most valuable timber volume.

Also, in dry season, the wildlife present in the area is most certainly located in the riverine forest. Clearing operations will favour the progressive departure of this wildlife prior to reservoir filling, limiting strongly the risk of having animals drowned or trapped on trees.

Additional zones from the deciduous woodland should also be cleared in order to facilitate the use of nets by the fishermen or safe transportation by boats. Some other areas should deliberately be preserved from clearing, in order to keep shelter areas for fish. Such zones will be recommended as a part of a Fishery Master Plan to be prepared.

The clearing strategy to select must satisfy the objectives listed above. The removal of soft biomass may be done without cutting but with simple burning of the alluvial and of the deciduous forests. Simple burning limits floating debris production and clogging risks for the inlets.

In case of limited interest of communities or contractors for wood removal, simple burning may be a solution, but will result in the loss of timber and will hinder the use of fish nets along the reservoir sides because of branches. So, burning could be combined with physical clearing along the most interesting parts (the widest) of the riverine forest for the collection or use of the wood, as much as the surrounding communities or some private enterprise are interested. The removal of the wood may be difficult, as there is no access to the bottom of the valley, except at the level of the Bele Bridge, in the middle of the reservoir. In many places, the wood may be harvested and transformed on site: poles, planks or even production of charcoal which later can be transported using donkeys.

Specific areas for clearing of the deciduous woodland may be identified in the fisheries development plan, and could therefore be cleared of all trees and larger bushes. The trees are of smaller size than in the riverine forest, and will be probably valuable only as charcoal or fuelwood. Again, valorisation will depend on the interest of local communities or companies. The wood cut and unused will be stockpiled, dried and burnt.

We may consider that all the area located below the mOL does not require clearing, except the riverine forest for valuable wood, if any. All this area may simply be burnt for the soft biomass reduction. Burning will release the carbon in the atmosphere as carbon dioxide (CO2), which has a GWP 25 times lower than methane gas.

The rest of the reservoir area, above the mOL and up to the MOL could be cleared in areas dedicated for fishing activities or just kept untouched in areas considered as refuge for fish[42]. Additional areas may be cleared later on, if necessary for the fisheries, during the seasonal drawdown. Wood may also be collected in the drawdown area for fuelwood on a longer term.

[41] 11 hours at full operation (1000 m3/s) and 13 hrs at <100 m3/s

[42] This strategy was applied for the Nam Theun 2 (Lao PDR) reservoir, cleared in selected areas only.

Table [18] - Pre-impoundment Clearing Strategies

Strategy	Advantages	Disadvantages
1) Do Nothing	Long term fish yield increased through increased nutrients. Standing trees provide : - protection for several fish species - environment for algal growth Very low cost.	Rapid de-oxygenation of bottom water and methane generation results in greenhouse gas emissions High nutrient load can cause rapid growth of large floating macrophytes which can provide habitats for vectors for various diseases and also clog turbines. Navigation and gill net fishing is hindered. Re-oxygenation by wind mixing is hindered. Loss of valuable timber. Methane generation results in large greenhouse gas emissions.
2) Cut trees without removal	Long term fish yield increased through increased nutrients. Permits fishing and navigation.	Rapid de-oxygenation of bottom water and methane generation results in greenhouse gas emissions High nutrient load can cause growth of floating macrophytes which can provide habitats for vectors for various diseases and also clog turbines. Release of floating debris with risk of clogging various inlets Labor intensive. Promotes shoreline erosion through soil instability. Loss of potential fish habitats. Loss of valuable timber.
3) Cut Trees with removal	Reduces oxygen demand Sale of valuable timber Permits extensive fishing and reservoir navigation. Reduces total greenhouse gas emissions.	Very costly. Logistic problems in removing materials. Lower overall lake production. Promotes shoreline erosion through soil instability.
4) Cut Trees and burning	Reduces total greenhouse emissions. Easier than hauling trees. Permits fishing and navigation.	Immediately dissolves inorganic nutrients. Potential for algal and macrophyte growth. Promotes shoreline erosion through soil instability. Loss of valuable timber.
5) Only burning	Reduces total greenhouse emissions. Long term fish yield increased through increased nutrients. Standing trees provide : - protection for several fish species - environment for algal growth Low cost. Keeps shoreline soil stability	Immediately dissolves inorganic nutrients with potential for algal and macrophyte growth Navigation and gill net fishing is hindered. Re-oxygenation by wind mixing is hindered. Loss of valuable timber.

For the ESIR Consultant, the main objectives and recommendations applicable to the reservoir clearing issue may be summarized as follows:

• Removal of maximum commercially valuable timber from the riverine forest. As evacuation of timber from reservoir area will be difficult, transformation on site (portable sawmill, production of charcoal) or removal of largest trunks by flotation during the filling phase should be considered.

• Cut and burn a maximum of the remaining vegetation. Experience of the ESIR Consultant[43] shows the possibility to rely on hand clearing in areas inaccessible by heavy equipment. This social approach is also in line with the request of major funding agencies to have such projects to generate benefits not only to the Government but also to local communities[44].

• Keep from place to place a tall tree (or a group of trees) intact to be used as a refuge for animals (monkeys, snakes) trapped by the rising water during first filling until rescue teams collect them (only few days of safety as water will raise by more than 1 m per day at the start of the first filling).

[43] Nam Leuk Hydropower Project reservoir in Lao PDR was totally cleared by hand by the Hmong communities. The cost was in average 420/ha US$ for clearing and burning for a 15 km² reservoir.

[44] For Nam Leuk, the clearing operation represented for the participating communities an income of 350,000 US$ over a 5 months period (1999).

• Avoid removing stumps as disturbed soil may increase both quantity and rate of nutrient release in water.

• Haul as much as possible of the burnt vegetation residual from the reservoir area

• Maintain a 200m wide buffer zone along the major creek channels to control sediment movement down the reservoir and additionally to provide habitats for fish and to preserve them against commercial fisheries (nets can hardly be used because of the branches)

• Preserve at least a 100 to 200m wide vegetation strip around the perimeter of the reservoir so that the intact root structure of the trees will help bind the soil and reduce shoreline erosion and wave erosion. This will also provide shelter for fish at the time of high water.

• Observation from previous projects shows that after clearing and burning, large volumes of partly burnt material mainly composed of branches and trunks were becoming a hazard for the equipment and the outlet (middle outlets, power intake and spillway) during the first floods which partly fill the reservoir. Special measures will be required to collect the debris and to haul them on appropriate landing grounds to collect and transform those which may be usable and to burn the others.

The detailed clearing plan shall be prepared on the basis of the additional vegetation and wildlife surveys to be carried out by Addis Ababa or Awasa Universities upon request of EEPCo. The investigations will assess in further details the hard and soft biomass observed in the riverine forest and identify valuable wood volumes and trees of scientific interest for which additional research or seed collection may be required. The Plan will also identify potential opportunities for the collection, transformation and marketing of the timber, and the manpower potentially available for the clearing.

7.3 Reservoir First Impoundment Issues

The first filling event is probably the most important and impacting stage of a hydropower project. Indeed, this is the period during which :

• Hydrology of the downstream system is abruptly modified, and

• Water quality of the system is strongly altered.

First Filling Procedure

The ESIA or the ESIA-DS do not address the issue of the first impounding procedure. The procedure was prepared by the EPC Contractor after the finalization of the ESIA, and the results were first presented to EEPCo in June 2009 in Addis Ababa. The present section provides an analysis of these results.

First impounding has been subject of simulations with the following conditions:

• Inflow according to series of 3 successive years, representative of average, wet and dry years; average years impounding situation is illustrated below (see Figure [15] and Figure [16] next pages). Illustrations for dry and wet years are provided in Appendix [11].

• Released (ecological) discharge of 25 m3/s when the power plant is not in operation;

• Artificial floods of 1,000 m^3/s during 10 days early September,

• Minimum Operating Level at el. 854 m for the commissioning of the generating units;

• River closure and starting of impounding 1st May 2013,

The procedure for the average year is depicted on the following pages.

The following technical comments are made by the ESIR Consultant:

1. The date for the starting of impounding is in accordance with the Contractor's construction program issued end 2009;

2. The duration of the commissioning of the units is 45 days, in accordance with the construction program, but **starting when the reservoir has reached el. 854** (mOL), while:

• The elevation 854 is the minimum operating level, but the operation of the units with the exceptional minimum reservoir level 800 is possible.

• The possibility of operation with the reservoir at el. 800 is in accordance with the provision of the revised Contract Agreement.

• The power intake and the headrace tunnels have been set at a low elevation to allow operation at this exceptional mOL, to permit an early operation of the plant.

• The turbine characteristics allow the operation at such a low head. In such conditions, the discharge capacity of one turbine is 75 m3/s, and the power of the generating unit will be 80 MW.

3. The released discharge of 25 m3/s is very low, but it corresponds to the discharge capacity of both conduits of the bottom outlet structure just after the closure when the reservoir level is around el. 684. The capacity of the conduits rises very quickly, and **can reach almost 100 m3/s a few days after the closure of the diversion**.

4. The artificial flood (discussed in the next section related to downstream hydrology) is with a maximum discharge of 1,000 m3/s, which is **significantly below the discharge of 1,400 m^3/s** thought to be necessary to reach the target of 1 600 m3/s in the low reaches of the river.

According to the assessment of the EPC Contractor, the filling of the reservoir will take:

• 18 months for an average series of years, with the commissioning of the units starting in Nov 2013, and total outflow downstream Gibe III dam of 53% of the related 2 year inflow;

• 18 months also for a series of dry years, but with the commissioning of the units starting only on July 2014, and a total outflow downstream Gibe III dam of 37% of the related 2 year inflow;

• 8 months only for a series of wet years, with the commissioning of the units starting in October 2013 and a total outflow into the river of 59% of the related 2 year inflow.

In an average inflow year situation

In an average inflow year situation, the operation at exceptional mOL 800 will allow the commissioning of the first units 3 months before the indicated date, and allow from September 2013 a discharge of 75 m3/s with a delivered power of 80 MW, and from November a discharge of 150 m3/s, with related available power of 160 MW.

With the proposed program, the storage of the reservoir will be 9.4 Mm3 the first year against an inflow of 13.8 Mm3. The total release to the river will be 4.4 Mm3, i.e. **32% of the inflow of the year**.

Then, with an earlier commissioning of the units at el.800 :

1. The additional release through the turbines will be around 1.5 Mm3, leading to a total release of 5.9 Mm3 the first year or **43% of the inflow**,

2. The consideration of the saturation of the rock mass around the reservoir[45] which has been assumed to represent 11% of the reservoir volume (which is still to be confirmed by further investigation and testing), is not considered in the EPC Contractor simulations, and this will lead to:

• 10 more days to reach reservoir el.800,

• the reservoir to reach el. 850 at the end of the first year instead of el. 860 presently shown,

• a similar outflow still representing 32% with the envisaged program and 43% of the inflow if the commissioning of the first unit starts when the reservoir reaches el. 800 and if the units are run at full power.

In a dry inflow year situation

In a dry inflow year situation, on average, the operation at exceptional mOL 800 will allow the commissioning of the first units 11 months before the indicated date, and allow a discharge of 80 m3/s from September 2013, and 160 m3/s from November with related available power of 80 and 160 MW respectively.

With the proposed program, the storage of the reservoir will be 6.5 Mm3 the first year, against an inflow of 10.6 Mm3. The total release to the river will be 4.1 Mm3, i.e. **39% of the inflow of the year**.

Then, with an earlier commissioning of the units at el. 800,

1. The additional release through the turbines will be around 1.5 Mm3, leading to a total release of 5.6 Mm3, or **53% of the inflow**,

2. The consideration of the saturation of the rock mass around the reservoir which has been assumed to represent 11% of the reservoir volume (which is still to be confirmed by further investigation and testing), will lead to:

• 20 more days to reach reservoir el. 800,

• the reservoir to reach el. 830 at the end of the first year instead of el. 840 presently shown,

• a similar outflow still representing 39% with the envisaged programme and 53% of the inflow if the commissioning of the first unit starts when the reservoir reaches el. 800 and the units are run at full power.

With the earlier commissioning program envisaged, more water will be released during the second year, and the cyclic evolution of the reservoir elevation will start in the 3rd year with an incomplete reservoir volume.

The proposed program with the late commissioning of the units leads probably faster to the stabilized operation mode with maximized dependable capacity. The consequences in terms of minimum release of water to the downstream reaches of the river and of late delivery of the first energy to the grid are important and may lead to the preference of earlier energy delivery, although the energy will be produced with a lower head and a lower efficiency of the turbines.

Behaviour of the Reservoir during First Filling

The flooding of the reservoir area will be fast as presented in the following table which reflects the results of the simulations.

Table [19] - Speed of Water Raise and Flooding during First Impoundment

	Average Years	Dry Years	Wet Years
Water level raise Month 1 (m)	30	25	70
Water level raise Month 2 (m)	40	40	35
Water level raise Month 3 (m)	50	35	45
Reservoir Area end of Month 1 (ha)	1,000	800	3,300
Reservoir Area end of Month 2 (ha)	3,200	2,800	6,000
Reservoir Area end of Month 3 (ha)	7,600	5,600	12,000

The water in the reservoir will raise by about 1 to 1.8 m/day during the first 3 months after closure, and will raise by more than 2.0 m/day the first month in case of wet year. Similarly, the flooded area will expend by about 80 ha/day during the first 3 months in case of average year (about 30 ha/day the first month, 150 ha/day the third month. In case of wet year situation, the reservoir expansion will be around 110 ha/day the first month and 200 ha/day the third month.

[45] Also assimilated to the "leakage" from the reservoir, but which happens only during the first reservoir filling. In operational situation, leakage from reservoir is considered by the studies as insignificant.

The speed of the filling will strongly limit the efficiency of the rescue teams proposed in the ESIA. Indeed, for a canopy of the alluvial forest 15 to 20 meters high, the rescue teams will have only 10 to 20 days to proceed to the evacuation of the trapped animals over at least 80 to 100 km of river. Unless dozens of boats are mobilized and a complex organization is set up (in particular for the evacuation of the rescued animals), it is hardly believed that such operation will be very efficient.

The dynamic of the first impoundment fully justifies the proactive intervention of clearing in the riverine forest before the first filling starts in order to reduce as much as possible the wildlife presence.

7.4 Reservoir Routine Operation Issues

Drawdown Zone

The reservoir level will fluctuate annually in average between 892 m (Maximum Operation Level, MOL) and 854 m (regular minimum operation level, mOL). Under exceptional conditions, the Project has the capacity to operate with a water level as low as 800 m (exceptional mOL). Translated into reservoir areas, these levels correspond respectively to 209 km² (MOL), 140 km² (mOL), 66 km² (exc. mOL). In average, every year, up to 70 km² of flooded land may be exposed to the atmosphere. This will have several implications including:

- Access facilities to the reservoir, for the public to cross it or the fishermen to access to boats will need to be designed in order to adjust to the water level and to facilitate the crossing of the drawdown area;
- At least the upper part of the drawdown zone will be exposed at least 3 months per year, which is sufficient to cover one crop cycle practice under recession agriculture. Areas supporting suitable soils with agriculture potential are yet to be identified for possible future development.
- The loss of grazing land in the reservoir zone is marginal, i.e. approximately 5% of total grazing area in each of the kebeles affected. As the land is a community resource, compensation has been designed accordingly, i.e. improved livestock feed resources and veterinary clinics. However, most of the drawdown zone will develop grass cover during its exposition period, suitable for livestock grazing.

Public Health

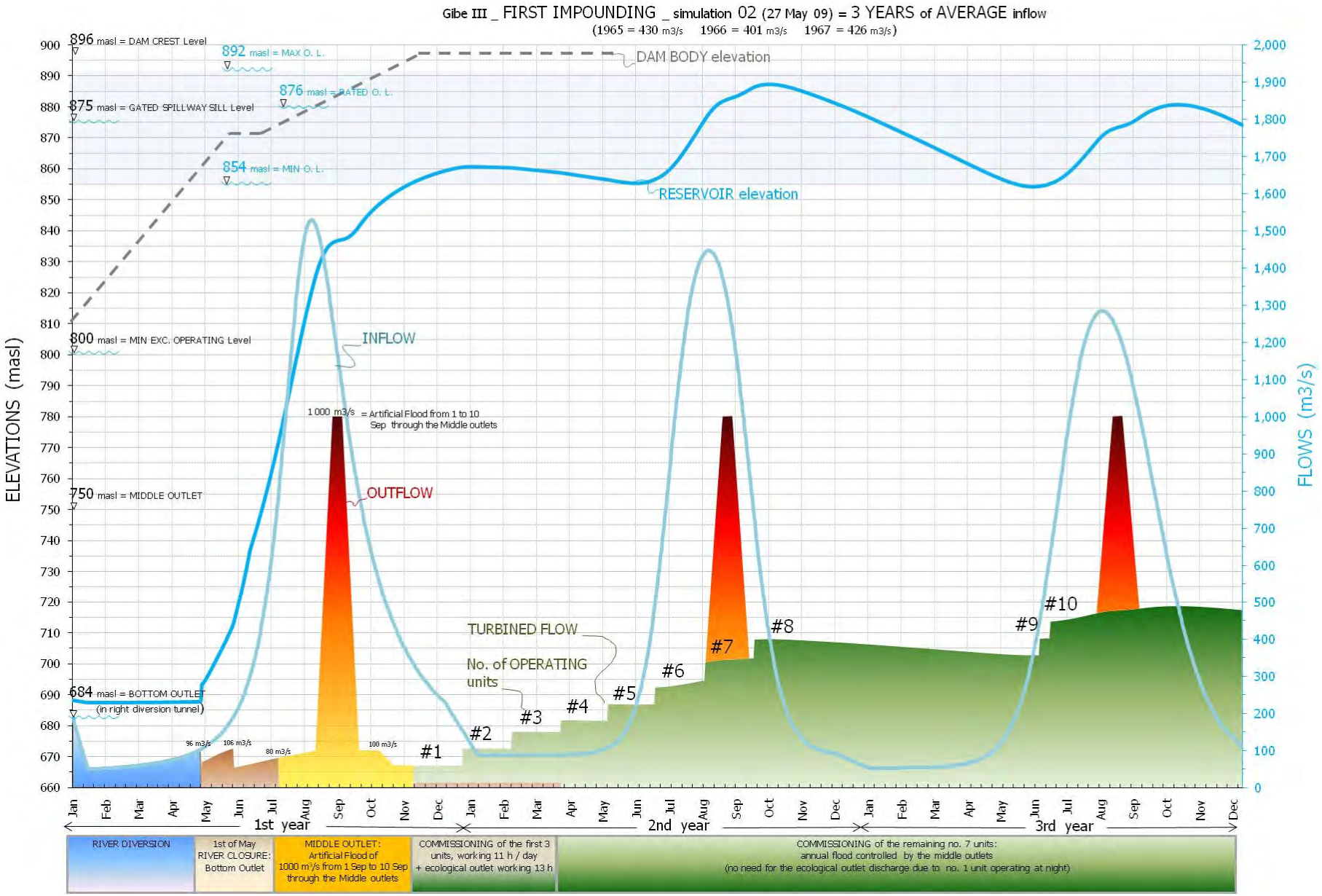
The ESIA anticipated the risk of development of diseases already identified (or expected) in the area as malaria, bilharzias, river blindness and tsetse fly.

This issue has been addressed in the ESIA and in the RAP which recommend additional investigations and monitoring. The ESIR Consultant is sceptical about the risk as the reservoir surrounding environment will not provide a suitable habitat for these vectors:

- Tsetse fly requires dense shadow and humidity as observed in alluvial forest. Because of the seasonal drawdown, it is unlikely this type of dense forest develops around the reservoir and the existing alluvial forest is flooded;
- Mosquito development, vector of malaria, requires stagnant water preserved from open waters (because of larvae predators). The development of dense floating vegetation is unlikely because (i) the low risk of reservoir eutrophication, (ii) the shape of the reservoir which reduces pockets of stagnant shallow waters and (iii) mainly the seasonal drawdown which will regularly expose and flood vegetation growing along the lake perimeter.
- The variation of the water level will similarly limit the permanent grass vegetation along the water which is required by the mollusc species vector of schistozomiasis (bilharzia) for their development.

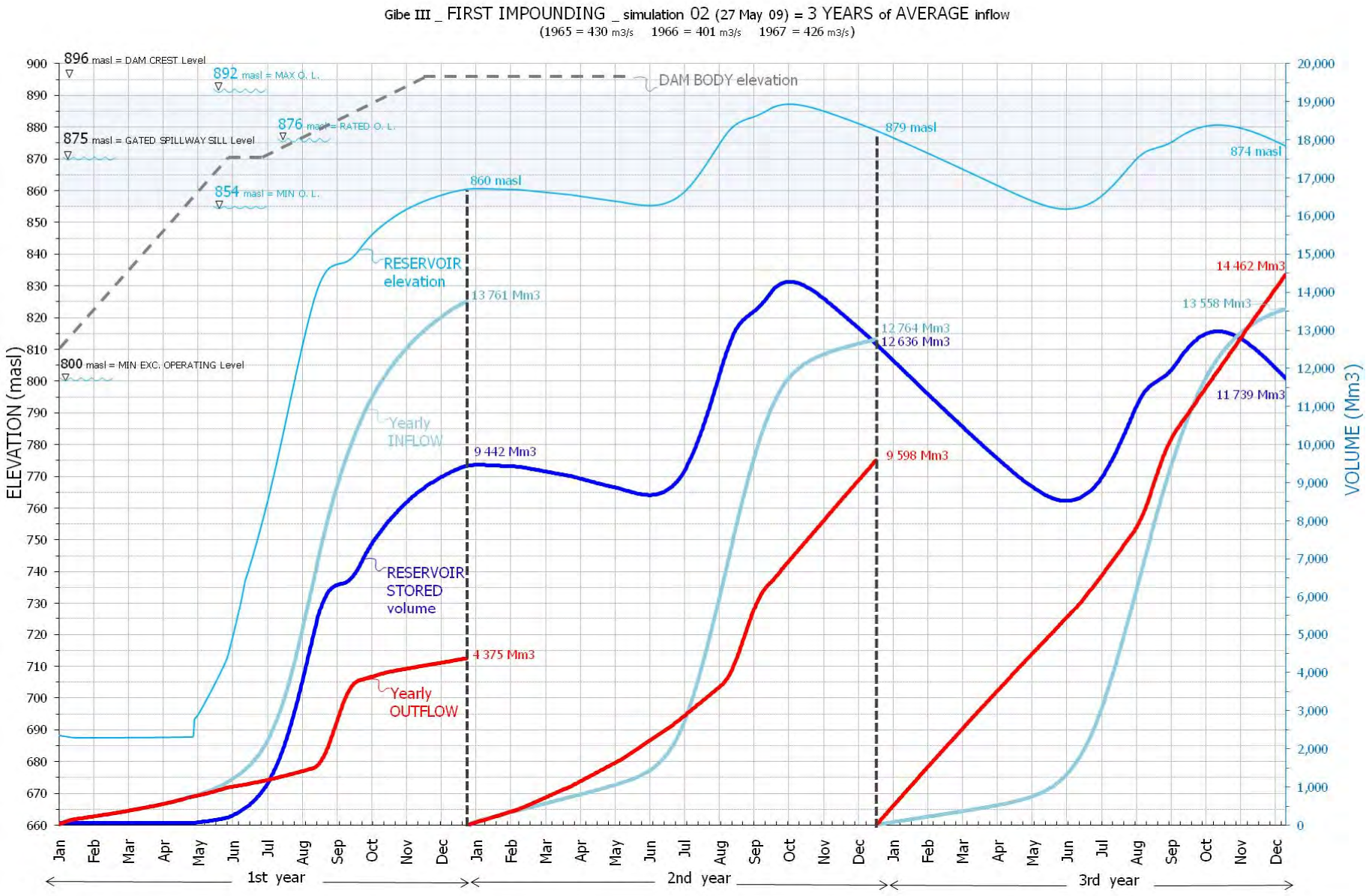
Concerning bilharzias and river blindness, the ESIR Consultant considers the risk to be more focussed on the Lower Omo should irrigation be developed, as irrigation channels with vegetation represent a favourable habitat for the vectors.

Figure [15] - Gibe III First Impoundment Procedure (Average Years)



Source : EPC Contractor

Figure [16] - Gibe III First Impounding Procedure – Evolution of Reservoir Volume (Average Year)



Source : EPC Contractor

7.5 Downstream River Hydrology Issues

The filling of the reservoir and the energy production during the operation stage of the project will result in major changes regarding the downstream hydrology and all human activities depending on the river:

- During first filling, the water volume stored in the Gibe III reservoir will represent a deficit in the water balance of Lake Turkana. This aspect has been raised at international level and is not discussed in the ESIA documentation.
- During the reservoir operation, the downstream hydrology will be modified from its natural seasonal pattern: regulation of the discharge over the year, with disappearance of the seasonal floods and increase of the flow during the dry season.

Without mitigation, major impacts of the seasonal regulation will be drying of the flood plain and the reduction of the recession agriculture presently developed along the downstream Omo.

As this type of agriculture is critical to the survival of the local population, the ESIA-DS proposes the discharge of additional water from the dam on a seasonal basis (early September) to simulate flood conditions and thus sustain flood recession agriculture and regeneration of the flood plain. It is considered in the ESIA-DS that a discharge of 1400 m3/s (equivalent to 1600 m3/s in the downstream plain) during 10 days (1st to 10th September) will satisfy the needs.

The following sections provide a critical review of the future downstream Omo hydrology during its first filling period and its operation phase and an assessment of the feasibility of the controlled floods proposed for mitigation in the ESIA-DS.

During Reservoir First Impoundment

The filling of the reservoir will deprive the downstream Omo River and eventually Lake Turkana of the water initially stored in the Gibe III reservoir and will alter the river natural hydrology.

In accordance with the procedures for first filling described in the previous section, the downstream hydrology will be modified during the initial stage of filling, after the closure of the temporary diversion. The situation will vary depending on the hydrological years observed during the filling period (average, dry or wet). Results from EPC Contractor simulations are summarized in the following table. Some comments are presented below (see Table [20]).

The reduction of downstream flow is the highest the first year of the filling for the average and the wet year sequences. This reduction ranges roughly between 60 and 70% of the related inflow at Gibe III. However, as discussed above, the early start of turbine commissioning at el. 800 instead of el. 854 may significantly increase the flow the first year and reduce the impact on Lake Turkana.

For example, during the first year of the average sequence, the outflow released to the river system is 32% of the inflow under the el.854 alternative, but may rise to 43% if turbines start at el.800, resulting in a reduced level drop of Lake Turkana limited to 1.21 m instead of 1.39 m.

Table [20] - Outflow during First Impounding and Impact on Lake Turkana Level

		Inflow G3 (Mm3/yr)	Outflow G3 (Mm3/yr)	Reduction (Mm3/yr)	Reduction (% Inflow)	L. Turkana Level Change
Normal Year	Year 1	13,761	4,375	9,386	68.21	-1.39
	Year 2	12,764	9,598	3,166	24.80	-0.47
	Year 3	13,558	14,462	-904	-6.67	+0.13
	Total 3 Years	40,083	28,435	11,648	29.06	-1.73
Dry Year	Year 1	10,632	4,137	6,495	61.09	-0.96
	Year 2	13,095	4,600	8,495	64.87	-1.26
	Year 3	97,91	13,221	-3,430	-35.03	+0.51
	Total 3 Years	33,518	21,958	11,560	34.49	-1.71
Wet Year	Year 1	19,586	5,416	14,170	72.35	-2.10
	Year 2	15,594	15,391	203	1.30	-0.03
	Year 3	20,361	21,508	-1,147	-5.63	+0.17
	Total 3 Years	55,541	42,315	13,226	23.81	-1.96

Impacts during Routine Operation

During the routine operation of the reservoir,

- Daily flow will be altered as the energy production will not be permanent;
- Seasonal floods will be strongly regulated;
- Dry season flow will be increased.

Daily Flow Fluctuations

Daily flow fluctuation results from the operation of the dam for energy production. Operation of the turbines is presently anticipated on a basis of **11 hours per day**. It means that during this time, the full operation of the 10 turbines will result in a discharge of 800 to 1,000 m^3/s. The remaining 13 hours per day, the downstream discharge will be limited at least to the **compensation flow fixed at 25 m^3/s in the ESIA,** or to a minimum discharge of 100 m^3/s or more should base load energy demand requests the permanent operation of one turbine or more.

A modelling study was performed as part of the ESIA-DS in order to assess the daily water level fluctuation in various stretches of the river. Reference situation of the modelling is the dry season, when the daily flow fluctuation is the most contrasted. It resulted from the modelling that the water level fluctuation in the river will be about 6m close to the release point, about 3m (the ESIA-DS considers 2m in the text, but figure 4.11 indicates 3m) about 200 km downstream the dam and about 0.20m (The ESIA-DS considers 0.10 m in the text, but figure 4.12 indicates 0.20 m) 400 km from the dam.

The daily flow fluctuation is at its maximum close to the dam site and gradually limited to about 20 cm 400 km further downstream. If the situation seems acceptable along the second half of the river course, it raises **public safety** issues for first half of the river course. Sudden water waves will flow down the river at each start of turbine operation, with risks for the human population but also for the wildlife and the livestock which may move close to the river bed when the water is at its lowest and be flushed down by the wave with high probability of drowning. This may also create erosion of river banks and scouring.

To mitigate the potential public safety risk, the ESIA-DS proposes to install an acoustic warning system (sirens) distributed along concerned sections of river which may be triggered prior each start of the turbines and alert the population that flow will raise soon. For resident population living close to the river, the system may work even if risk still exists for young children. But for pastoralists groups crossing the river occasionally as well as for wildlife and livestock, it is not certain the system will provide sufficient safety guarantees.

If alternative solutions as regulation dam downstream are not to be considered (huge size of the regulation reservoir to anticipate) more operational measures may be considered to limit the public safety risks. The first is **to keep a base load production of energy** which involves the permanent running of at least one turbine, with a discharge ranging between 60 and 100 m^3/s, a sufficiently high discharge to avoid peoples and animals staying in the middle of the river. Combined with a procedure to start the full operation of the turbines over a reasonable laps of time, say 1 hour, and the use of the acoustic system could provide a more reliable safety management.

The ESIR Consultant considers that the ecological discharge of 25 $m^3.s$ is by far too low. An appropriate value should be in the average discharge value of the driest month, March, which is 61 m^3/s. An ecological discharge of 60 m3/s should be acceptable for the ecosystem and better than the 25m^3/s proposed: indeed, the 25 m^3/s discharge can only be done through the ecological outlet, and the water is not turbined. As the turbines are of the Francis type, they should accept a low discharge of 60 m^3/s, which means that the ecological discharge in this case can be turbined and becomes profitable.

Inter-Seasonal Flow Fluctuations

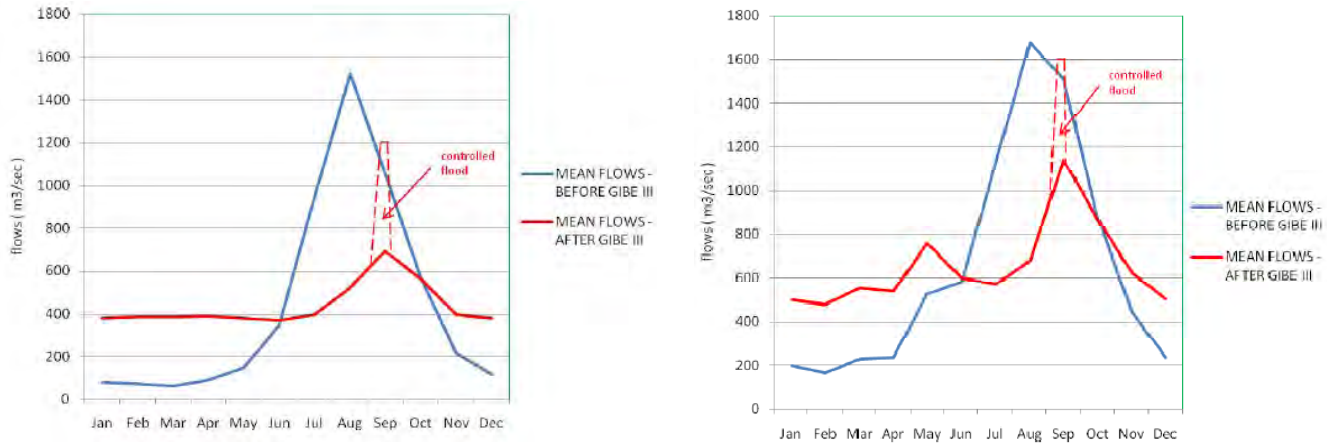
As most hydropower projects, Gibe III generates energy all year long storing water in the reservoir during the rainy season to release it during the dry season. The originally contrasted flow of the Omo just downstream Gibe dam (average 61 m3/s in driest month-March and average 1,529 m3/s wettest month-August) will be much more regulated in the future, with higher flows during the dry season (400 m3/s) and lower ones during the wet season (peak of 700 m3/s in September). A similar change will be observed at the delta level, where Omo river inflows into Lake Turkana, modified in accordance with the regime of the natural floods from the intermediary catchment, as presented in the Figure [17] below.

The main beneficial impact of this situation is a strong reduction in the occurrence of severe floods which affect regularly the Lower Omo and its Delta, sometimes with disastrous effects on livestock and population as in 2006 for example. The Gibe III project will efficiently control most of the floods and will improve public safety in the Lower Omo region.

The regulation of the flow will also secure water supply of the communities during the dry season and allow for year round irrigation, frequently hampered these last years by recurrent drought situation and extremely low level of water in the Omo downstream Omorate.

The negative side effects of this hydrological change are mainly related to the impacts on flood-recession agriculture, a common practice of the local population, and on the long term sustainability of the flood plain functions regarding its supported economic activities and its biodiversity.

Figure [17] - Omo River Flow at Gibe III and at Lake Turkana before and after Dam Implementation



Impact on recession agriculture is certainly a major social impact on the downstream area. Flood-recession agriculture is extensively practiced by the various communities of the lower Omo, particularly along the lowest 150 km of river course. This activity occurs locally on the sand deposits along the inner part of the river meanders, and more generally along the river banks when the water level drops. Production concerns mainly sorghum and maize.

The impact on the delta, which should dry up because deprived of seasonal flooding may even be more important considering the function of the delta for grazing lands, fisheries, recession agriculture and wetland biodiversity.

Mitigation by Controlled Floods

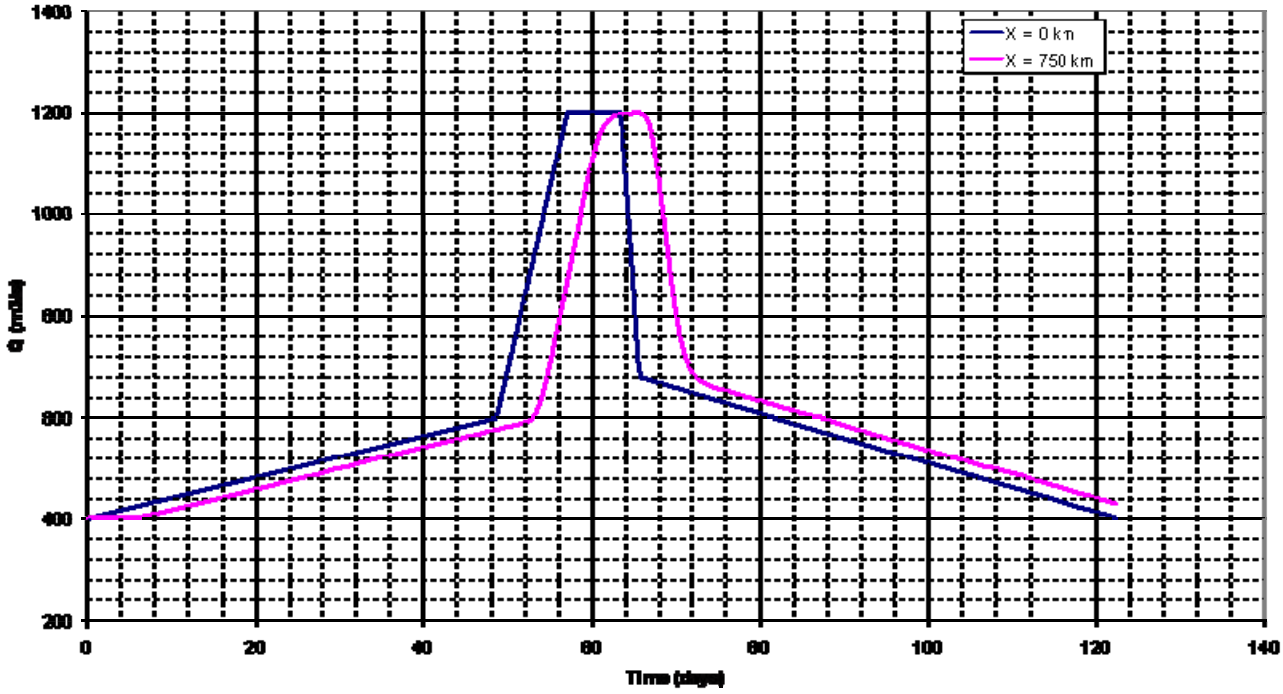
Without any specific measures, during the operation of Gibe III the water level in the river will only change little between the rainy and the dry seasons, cancelling most of the flooding occurrence of the plain and putting an end to the traditional flood recession agriculture. To mitigate this impact, the **ESIA-DS proposed controlled flooding early September**, through the release of additional water from the dam using 2 mid level outlets of about 500 m^3/s maximum discharge capacity each. The idea is to release enough water at the dam level for a duration of 10 days, which - when combined with the natural high flows from the intermediary catchment - should result in a discharge of about 1500 to 1600 m3/s at the delta level, a target value established by the ESIA-DS Consultant as satisfactory for flooding the river banks and the floodplain.

This raises the following comments from the ESIR Consultant:

- The estimate of the target discharge is based on a unique flood event observed from plane in July 2008, which seemed to have correctly flooded the depressions. However, it seems the flight was performed 9 days after the flood peak, and there is no information on the situation of these depressions before this flood event (they may have been flooded by a previous higher flood);
- In the ESIA-DS documents, the propagation of the flood is considered as immediate: the water released at dam site is immediately available downstream. A simplified model prepared by the ESIR Consultant (trapezoidal river section, no overflow) shows that 4 to 5 days are necessary for the targeted flood discharge to reach the delta (see Figure [18] below). Considering progressive overflow in oxbow lakes, depressions, the transfer time in actual situation will probably be longer;
- The duration of the flood: **the minimum flooding duration is 10 days**, corresponding to the time necessary for the weed seeds in the ground to start germination under water (7 days) and the time under water to kill the germ (3 days), in order to avoid later infestation of the sorghum field by weeds. It is probable that with the propagation time, more than 10 days of discharge may be required;
- The **sustainability** of such measure, considering the rising demand for energy and the occurrence of drought periods limiting inflow to the Gibe III reservoir. Conflicts may quickly emerge and it is probable that priority will not be given to recession agriculture; the cost of the controlled flooding is far from marginal as presented in the next section; for example, 600 m3/s discharged during 10 days represent a volume of 518 Mm^3;
- Controlled flood approach is **totally passive**: it maintains existing conditions, considered as a survival situation, without real proactive improvement (except maybe more security in the flood occurrence) and without additional economic development opportunities.

For these reasons, the ESIR Consultant proposes further below alternatives for water control in the lower Omo region.

Figure [18] -Artificial food (from Monthly flows at Gibe 3 site : average 1964-2001 to lake Turkana)



Energy production and cost of the controlled floods

Existing information

The Studio Pietrangeli (Consulting Engineer of the EPC Contractor) report compares several energy production scenarios including few presenting various releases conditions (see Table [21] below).

The release of the controlled flood leads to a **firm energy loss of 300 GWh/year and average total energy loss of 180 GWh/year**. The controlled flood has a larger impact on the firm energy than on the average total, because this release is more critical during the dry years and with limited impact during the wet years.

In the EFTA report, the controlled flood envisaged considered a total released discharge of 1,100 m³/s, with the spilling through the dam of a discharge of 150 m³/s additional to the discharge routed through the plant. The impact on the energy production of the scheme of the water release made within the framework of the controlled annual flood comes to a reduction of the produced energy by 65 GWh on average.

Table [21] - Energy Production Scenarios of Studio Pietrangeli

Scenario		No. 5: Firm Power 95% Guaranteed	No. 12: Idem Scenario 5 + release 22-24 m3/s	No. 13: Idem Scenario 5 + Controlled Flood[1]
Firm Power (MW)		1,345	1,290	1,200
Energy	Firm (GWh/yr)	5,400	5,200	5,100
	Secondary (GWh/yr)	930	930	1,050
	Average (GWh/yr)	6,330	6,130	6,150

[1] *Total discharge larger than 1100 m3/s at Gibe III to produce 1600 m3/s at Lake Turkana.*

Additional Calculations by the ESIR Consultant

Maximum energy loss

The release of 1,400 m³/s to the river, which is larger than the discharge capacity of the plant, implies necessarily a spillage through the dam, and generally a loss of water that could have been otherwise discharged through the generating units:

- When the reservoir is slightly below el. 892, the discharge capacity of the plant is 970 m³/s, and the requirement to release a total of 1,400 m³/s leads to a spillage of 430 m³/s that would have been otherwise stored and eventually routed through the generating units to produce energy;
- When the reservoir is around the average operation level, the maximum discharge of the plant is 1020 m3/s, and the spillage is reduced to 380 m3/s;

• When the reservoir is already at FRL 892, or already spilling, the additional spillage required for the release of 1,400 m^3/s is between 0 and 430 m^3/s.

The loss of water, and the resulting loss of energy to be produced depends therefore of the level of the reservoir at the time of the flood.

In the absence of requirement regarding the controlled flood, an operation strategy aiming at maximizing the production of energy will lead to minimizing of the spillage. Such a strategy would however result in maximum loss of water through the controlled flood release.

On the contrary, and still in the absence of requirement regarding the controlled flood, an operation strategy leading to maximize the dependable capacity, will lead to more spillage. This strategy would however result in less loss of water through the controlled flood release.

With controlled flood requirement, the conclusion is likely to be the same, but a dedicated operation optimization study remains to be carried out.

The best balance depends on the value of the dependable capacity and on the peak and off peak energy. We can however consider at this stage that the maximum volume of water released for the presently envisaged artificial controlled flood of 1,400 m^3/s during 10 days will be 371.5 Mm^3, with a corresponding loss of energy of 188 GWh/year. This figure is consistent with the loss of energy reported in the EFTA study for the controlled flood envisaged at that time.

Additional calculations

Additional calculations have been carried out in two steps:

1. Through the use of the Hillplan software which adjusts the operation strategy to the series of inflows available and imposed operational constraints;

2. Through an Excel program, with either an operation strategy defined to maximize the energy produced, or with a monthly target discharge similar to the one used in the existing studies, and the following constraints:

• Peak : 11 hours per day,

• Off peak : 13 hours per day,

• Minimum discharge during off-peak hours 60 m^3/s

• Controlled flood with a minimum discharge of 1,400 m^3/s 10 days in September.

The minimum released discharge of 25 m3/s retained so far in the reference study, which corresponds to the average discharge of March 1973, the driest month ever recorded, is considered too small to guarantee acceptable ecological conditions in the river. This discharge is also out of the continuous operating range of the turbines, and cannot be safely routed through one of the generating units to generate energy.

It has been replaced by a minimum released discharge of 60 m3/s, which corresponds to the long term average discharge of March. It is considered to be the minimum discharge able to provide sufficient ecological conditions in the river, and which is also sufficient to be safely routed through one turbine.

These calculations confirm:

• that the release of the minimum discharge of 60 m^3/s through the generating units reduces the peak energy and the dependable capacity during the peaking hours, as expected, but leads to no significant loss of the total energy produced,

• that strategies leading to the satisfaction of different objectives lead to different results in terms of dependable capacity and total energy produced, with the following consequences: (i) The strategy adopted in the actual operation of the plant will depend of the valuation of the dependable capacity and of the peak and off-peak energy, (ii) The quantity of energy not produced as a result of the release of the controlled flood depends also of the operation adopted for the plant.

• That the difference between the energy generated by the scheme with and without the controlled flood is likely to be between 130 and 180 GWh/year, depending of the objectives and strategy of the operation of the plant, and probably closer to 180 GWh, since this corresponds to an operation mode which maximizes the energy produced.

Cost of the Controlled Floods

We consider at this stage that the production loss related to the controlled floods (10 days, minimum discharge of 1,600 m3/s at the mouth of the Omo river is **an average figure between the minimum of 130 GWh/year and the maximum and most likely figure of 180 GWh/year**, indicated by the various calculations made within the framework of the reference study, the EFTA study and the present exercise.

Assuming a value of 6 US cents per kWh, the annual value of the energy not produced would be 7.8 M US$ for the minimum of 130 GWh/year, and 10.8 M US$ for the figure of 180 GWh/year.

For values of the discount rate of 12 and 8% over a 35 year period, the present value of this energy not produced comes to

• 65 to 91 M US$ respectively for the minimum figure of 130 GWh of not produced energy,

• 90 to 126 M US$ respectively for the maximum figure of 180 GWh of not produced energy.

Alternative Mitigation Options

Uncertainties about controlled flood efficiency, financial acceptability and limitations regarding regional development opportunities lead the ESIR Consultant to reconsider the appropriateness of this solution and propose an alternative solution: the downstream river water control.

Indeed, instead of discharging huge volumes of water from Gibe III to raise the river water level 600 to 700 km downstream, it may be worth to consider other alternative solutions to raise the water level from the downstream, through a weir or barrage facility. A possibility to ensure the feeding of the lowlands in the delta and the flooding of river banks is to build a diversion barrage across the Omo river at the start of the delta (just upstream of Omorate may be considered suitable for safety reasons), and divert part of the inflow into existing diffluent and/or into canals to be built on the inland side of the sediment bars along the river.

The width of the river in this area is evaluated about 120 m, and the water elevation could be raised by 6 to 7 m above the low flow river level. Such barrage would be designed so as to present a minimum obstruction to the routing of high floods, and allow for the flushing of the sediments that will otherwise settle in the river reach upstream of the barrage. Solutions as flap gate barrage or gated weir are both to be considered as they are flexible in their operation and may adapt quickly the water level to the needs. Both options provide the possibility to preserve, at least on the short term part of the recession agriculture activities along the river banks and to promote development of irrigation.

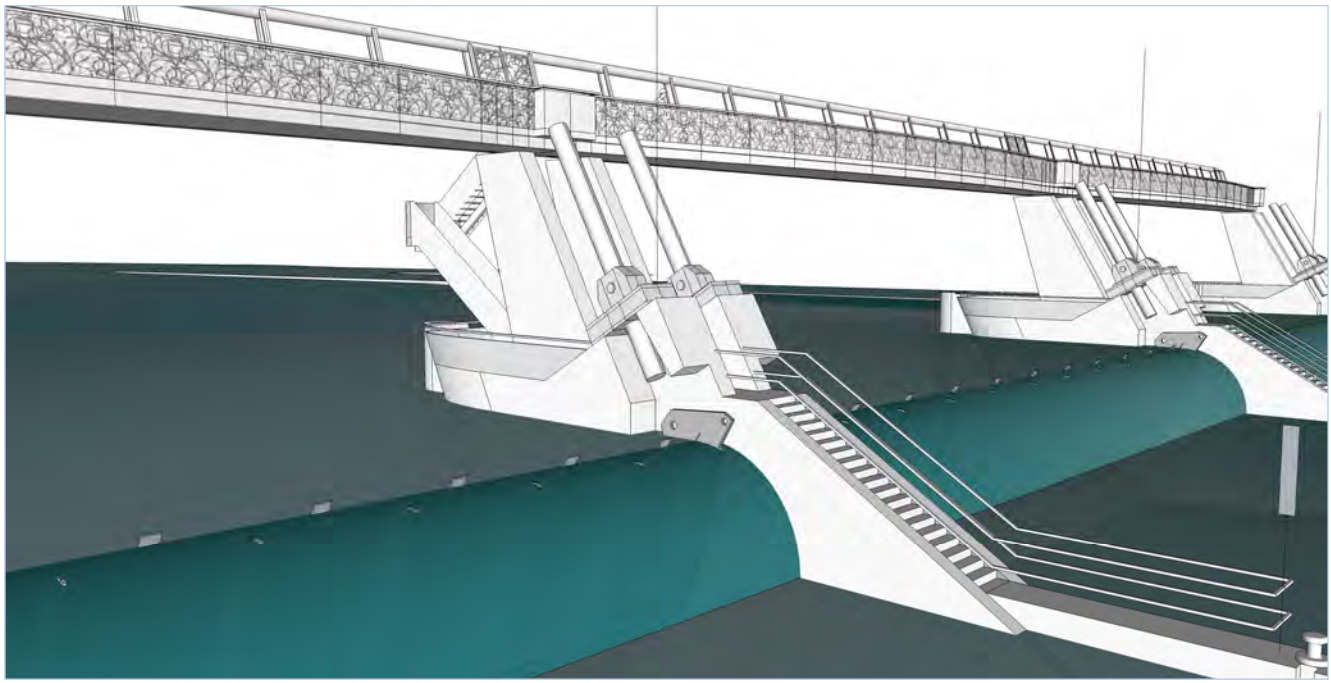
The structure intends to raise the water level in the river, to facilitate intake operation and to provide either flap gates or classical gates to allow the transfer of floods downstream.

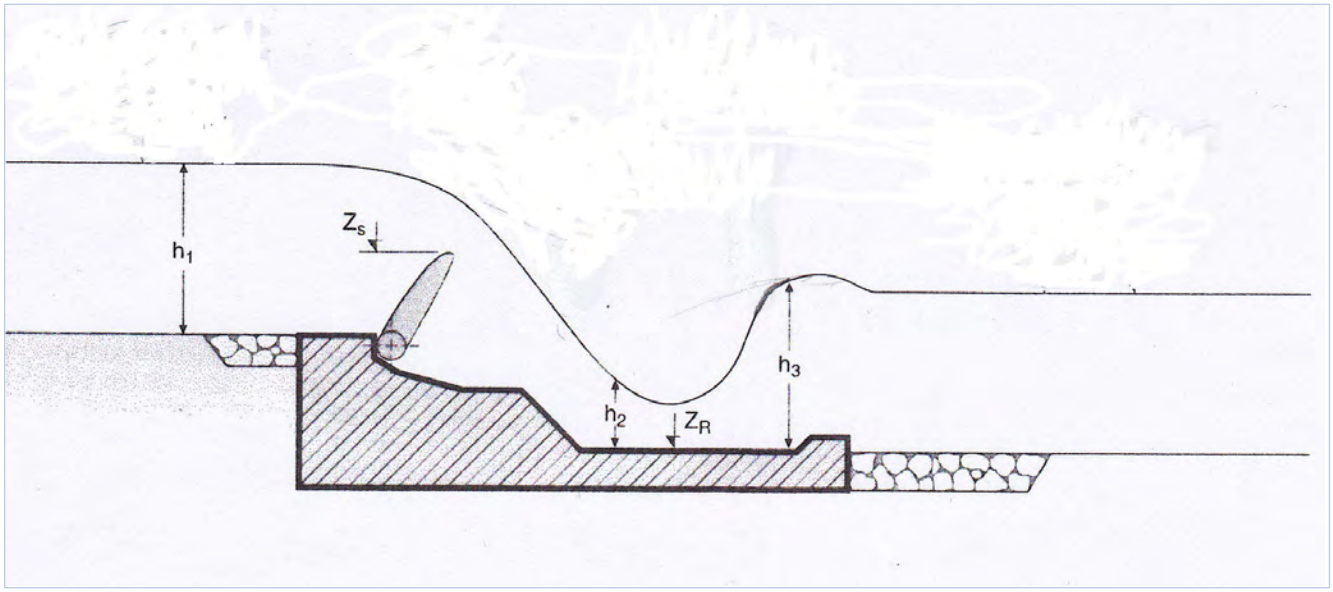
The principle of a flap gate barrage is depicted below (see Figure [19]), together with an architectural view of such a flap gate barrage presently under construction in France. This technology is frequently used for the raising of existing dams, and has already been implemented in several countries including in Africa. The structure allows raising the water level in the river by up to 6-7 meters at the end of the rainy season (i) to flood river banks (over a limited distance only depending on the river bed slope) and the alluvial forest, (ii) to recharge oxbow lakes and (iii) to divert water for the flooding of the delta. Also, combined with limited controlled flood discharges from Gibe III (if considered necessary), the flap gate may magnify the effect and thus reduce dramatically the volume required. Based on data available to the ESIR Consultant, the construction cost of such a structure (h = 7m, L = 120m), would be in the range of 30 to 40 M US$ (on the basis of works in France).

The gated weir, satisfies the same location principles than the flap gate barrage but may provide a higher level rise of water in the river bed, thus allowing easier permanent gravity water intake for irrigation. This solution is equipped with gates in order to allow floods being transferred downstream. The cost could be cheaper than the flap gate option.

Selection of option, location and design can only be established after topographical data of the river banks and of the delta is made available, as well as the mapping of the soil suitability for irrigation. The ESIR Consultant recommends that extensive topographical work is performed over the Lower Omo region as well as additional soil investigations.

Figure [19] - Example of Flap Gate Barrage





In addition to these barrage/weir structures, additional improvements may be considered:

Improvements of oxbow lakes water supply: Between chainage 350 and 660 km, where the river is densely meandering, a number of depressions or oxbow lakes are used by the population after flooding, for fisheries and recession agriculture; it is proposed to improve and facilitate the regular flooding of these areas through the construction of water intake and control structures and resizing of the feeding channels. This is the case of Lake Dipa, near Kara Korocho, which was not flooded for the last two years and which dried out in 2009.

Development of the delta: the purpose is to substitute the flood by a system which distributes water over the largest area to fill all the depressions where grazing land and recession agriculture may develop. The delta topography is typical, with a smooth slope and a river bed well incised in the sediment. The size of the trees in the riverine forest on the bank of the Omo indicates that the river bed is stable in location (it is probable that the drawdown of Lake Turkana during the last century has stabilized the river bed). The western part of the delta supports several small irrigated gardens fed by windmills pumping directly in the Omo rivers. The inner part of the delta includes large areas of recession agriculture. The eastern part is not developed, probably because of saline soils.

A former diffluent of the Omo river, starting north of the old Ethio-korean farm (upstream of Omorate), could be for example reactivated to direct water towards the eastern depressions.

A new canal following the left bank of the Omo River may provide several benefits:

- Feed the depressions with water to compensate for the disappearance of the natural flood;
- Improve the water supply of small holder irrigation schemes or gardens located along the Omo and which face difficulties for pumping in the Omo river during the dry season;
- Favour the development of new irrigation schemes in the western part of the delta.

These preliminary ideas are illustrated in the Figure [20] next page.

Impacts from Sediment Trapping

It is estimated by the EPC Contractor studies that 98% of the sediment entering the reservoir will be trapped. Water that will be released downstream of the dam will be free of sediments.

This will have effects on the riverbed dynamics. The first 200 km of river downstream Gibe III, with a relatively steep longitudinal slope in the hilly area is not a place for sedimentation, so limited material only can be removed from the bed. Erosion of the river bed may possibly be transferred further downstream, at the entrance of the river into the plain.

It is uncertain which sediment load the water will have recovered when it reaches the delta, as the intermediary catchment will also contribute to the load. Importance of river bed erosion at delta entrance is thus uncertain. However, the additional reduction of about 1.5 m of the Lake level because of the first impoundment will create an additional incision of the river bed into the delta sediments in order to re-establish a new balanced longitudinal profile of the river bottom.

In summary, sediments will not be a problem for the dam efficiency in the future, but may result in changes in river bed level further downstream and possibly also in the delta area.

Figure [20] - Illustration of possible development in the downstream area

Hydrological Impact on Lake Turkana

Some NGO documents raise that considerable losses of water at Gibe III during its operation will reduce the total annual inflow to Lake Turkana, resulting in a drop of 7 to 12 meters of its level. The situation analyzed by the ESIR Consultant is presented below.

Impact of First filling on Lake Turkana

As discussed previously, the first filling of the Gibe III reservoir may represent a water level decrease of about 1.7 m for Lake Turkana over the first three years period. But it must be understood that this decrease is not ADDITIONAL with the seasonal decrease of about 1.5 m resulting of the evaporation rate during the dry period much higher than the natural inflow to the Lake. This 1.5 m decrease will be, in the future, balanced during the dry season by the higher discharge from Gibe III, resulting from yearlong turbine operation. The water stored in the reservoir during the rainy season is released during the dry season. To simplify, the water level of the lake will stabilized most probably at a level very close to the level of the lake when the first filling start, at the end of the dry season.

Impact of routine Operation on Lake Turkana

During the routine operation of Gibe III, the level of the Lake will remain more or less stable, as the water stored during the 3 months of rainy season is released yearlong at constant flow. The seasonal fluctuations of the Lake level will be very limited (10 to 50 cm?), and only interannual fluctuations (dry or wet hydrological years) will significantly raise or lower the level.

Losses from Reservoir Evaporation

Net additional evaporation from the Gibe III reservoir represents the difference between the evaporation from the reservoir surface minus the potential evapotranspiration which occurs presently from the vegetation of the future reservoir. The technical study for the dam includes an assessment of the reservoir evaporation. It comes to the conclusion that the future reservoir evaporation will be 1,109.9 mm/year, the present reservoir vegetation evapotranspiration is 999.5 mm/year (rainfall 1,347.0 mm/year minus runoff 347.5 mm/year), resulting in a net evaporation of the Gibe III reservoir of 110.4 mm/year.

This represents a net water loss of only 19.8 Mm^3/year, a marginal volume considering the average inflow to Lake Turkana (about 23,000 Mm^3/year).

Losses from Reservoir Leakages

After the first filling of the reservoir, during which infiltration is considered to represent 11% of the reservoir storage capacity (initial filling of all the voids in the soil and the fractures of the rock mass) the leakage from the reservoir is generally insignificant, mainly considering the basalt material of the basement. Supposing a major leakage occurs, which may even jeopardize the economic viability of the project, all the water infiltrated will be drained eventually towards Lake Turkana as the Omo system is the lowest drainage system of the region.

Potential Losses from Irrigation

It is anticipated that irrigation will develop in the future, considering the regulated water supply and potential in soils. The ESIR Consultant estimates the water demand for irrigation between 10,000 and 15,000 m^3/ha/year. The ESIA-DS report anticipates, as mitigation, the development of 2,000 ha of small irrigation schemes, of 7,200 ha of large irrigation schemes and of 300 ha of small commercial farms. This total represent a water volume abstracted from the inflow to Lake Turkana of 80 Mm^3/year, or 0.35 % of the total inflow to Lake Turkana.

Total water inflow reduction to Lake Turkana and impacts on its chemical balance

With the 20 Mm^3/year of evaporation loss from the Gibe III reservoir and 80 Mm3/year from irrigation, the total anticipated flow reduction to Lake Turkana may be estimated at about 100 Mm^3/year or only 0.4% of the total average annual inflow to the Lake (23,000 Mm^3).

This represents the direct short term impact from the Project. However, as already mentioned, the Lower Omo provides much more opportunities for the development of irrigation schemes. In 2009, a regional study team has identified 305,511 ha of land for different investment activities in South Omo Zone. Of which, 180,604 ha were proposed and transferred to Ministry of Agriculture and Rural Development. Four project zones were identified; they are briefly described in the following table.

Table [22] - Projects identified in 2009 by the GoE for irrigation development in the South Omo area

Location	Woreda	Capital town	Area (ha)
Southern part of South Omo zone	Dasenech	Omorate	76,409
Western part of South Omo zone	Nyangatom	Kangati	71,473
Central part of South Omo zone	Hamer	Dimeka	16,292
Northern part of South Omo zone	South Ari	Gazer	16,451

The first three projects located in Dasanech, Nyangatom and Hamer woredas will require irrigation scheme implementation. The fourth is located in a region where annual rainfall is close to 800-1,000 mm and should not require irrigation. At least a part of these areas may be developed in the long term.

As a first approximation based on the 1996 Master Plan, soil surveys areas suitable for irrigation were estimated about 100,000 ha. Applying annual irrigation doses in the range of 10,000 to 15,000 m3/ha/year, the eventual annual demand for irrigation water may raise to about 1,000 to 1,500 Mm3 per year, or about 4.3 to 6.5% of the total inflow to Lake Turkana.

This analysis may even be representative of the worst case scenario as it does not consider some additional water inflow to Lake Turkana in the future. Indeed, a significant factor in the lake's water balance is represented by the extent of the delta floods in the future. At present, large areas of the floodplain are seasonally flooded, and the evaporation from this water surface represents probably significant volumes of water lost for Lake Turkana. A precise assessment of these volumes is not possible before further information on delta topography is available (recommended as a major component of the studies proposed by the ESIR Consultant). In the future situation, the flood volumes and flooded areas may possibly be smaller than in the present situation, resulting in less evaporation loss and more water directly available to Lake Turkana.

Considering the most probable limited reduction of Turkana Lake annual inflow resulting from Gibe III Project in the short term, the ESIR Consultant does not anticipate significant impact on the chemical balance of the Lake. This issue could be more significant on the long term, should extensive irrigation schemes be developed by the Ethiopian Government. The issue should be addressed in further details during the additional studies on Lake Turkana recommended by the ESIR Consultant.

7.6 Impacts of Hydrology Alteration on Downstream Ecology

Terrestrial Ecology Issues

Some NGOs documents predict the progressive destruction of the Lower Omo riverine forest because of the reduction of the flows and of the floods. This is not the opinion of the ESIR Consultant, considering that:

Riverine forest doesn't rely on flood occurrence but on the alluvial aquifer which provides, in arid areas as the Lower Omo, yearlong access to the tree roots. With Gibe III, the flow will be regulated and will stabilize the alluvial aquifer level at a slightly higher level than its present average level. This will be beneficial to the development of the trees and shrubs with a root system long enough to reach the aquifer (not a too restrictive constraint as the aquifer level will be higher and only few meters below ground level deep);

During the reservoir filling, the discharge in the river will be reduced, but will not fall below 50 m3/s in average just after the rainy season (November and December, when the first turbine is operating). Quickly, the other turbines are commissionned and the discharge increased quickly. This should not have any significant effect on the alluvial aquifer, mainly if the controlled floods of the first year of the impoundment are maintained.

The reduction of seasonal floods will mainly affect the grass cover within the alluvial forest, which is shallow rooted and can collect water only from the upper part of the soils where it is provided by flood or rainfall. The grass cover will probably reduce in density and diversity; however, the organic sediment bring by the flood will disappear and the fertility of the soils may reduce progressively;

The river in the plain will never runs dry during the first filling period. There should be direct no impact on the wildlife living in the alluvial forest.

For the same reasons, significant impacts on wildlife in the National Parks or other protected areas are not anticipated. Access to river will remain unchanged, and on the longer term, should recession agriculture be abandoned for irrigation, access to river should even improve for animals.

The Project should not have detrimental impacts on the National Parks, except may be a boundary between the Mago and Omo national Parks (the Omo river) more difficult to cross in the dry season because of a higher dry season flow. However, according to the Management of the Mago National Park, movements of wildlife across the river are already extremely limited. It is the opinion of the ESIR Consultant to further assess the situation on these points through complementary studies on wildlife, in coordination with the park Authorities.

Aquatic Ecology Issues

River Ecology

After the reservoir impoundment, the water quality released downstream will change when compared to the present situation. Immediately below the dam, the high content of methane gas and the absence of dissolved oxygen combined with the severe daily flow fluctuation will definitely impact the aquatic ecology and the fish population. It is anticipated that the water will have recover its quality at the entrance of the plain (and probably before).

The major changes anticipated concern:

- The water temperature, several degrees lower than usual, because water intake is located at a low level in the reservoir; however, the water will have time to warm up and will probably recover its usual temperature before it reaches the middle of the plain;

• The suspended sediment load, which creates at present high turbidity of the water and limits the productivity of the ecosystem (limited penetration of sunlight and low phyto-plankton production), will strongly reduce with Gibe III, most of the sediment being trapped in the reservoir. The water released will be clearer, allowing for development of plankton and algae, improving the food supply for the fish populations.

Wetland Ecology

The magnitude of impacts on the delta wetland will depend on the capacity to maintain an acceptable seasonal flooding of the delta. Without mitigation measures, the flooding of the delta will be stopped, the pastureland will dry up and will be progressively invaded by drought resistant shrubs and grass species from the surrounding lowland vegetation communities.

Should the controlled flood or other mitigation be implemented, the impact will depend on the area effectively flooded and the duration of the flood. In flooded area, the present natural flood pattern may be preserved while in higher or remote places, out of reach of the substituted flow, may dry up and turn to shrubland.

On this aspect, only hypothesis can be formulated at present in the absence of a detailed topography of the delta and of the vegetation communities, not yet studied. This is a major issue to be addressed in the study package recommended by the ESIR Consultant.

7.7 Climate Change Issues

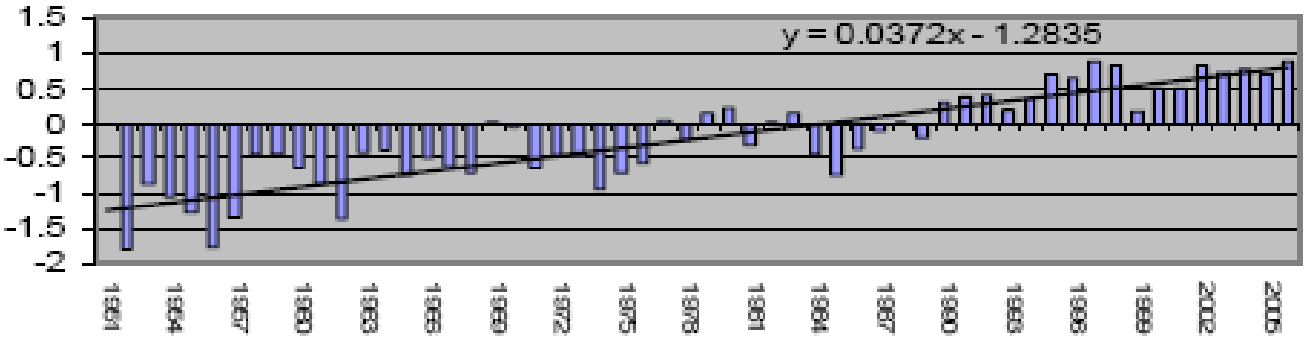
Present Trends of Climate Change in Ethiopia

The population interviewed in the Lower Omo area raised the observation of more erratic precipitation with sometimes catastrophic flood events, higher temperatures and more frequent drought situations.

Major floods which caused loss of life and property occurred in different parts of the country in 1988, 1993, 1994, 1995, 1996 and 2006. For example in the 2006 main rainy season (June- September), flood in the Omo region (NMA, 2006) resulted in the death of more than 364 people, and more than 6,000 people displaced due the flooding of about 14 villages. Additionally, more than 900 livestock drowned, 2,700 heads of cattle and 760 traditional silos were washed away (WFP).

The National Meteorological Agency carried out studies regarding climate change (MWR, National Meteorological Agency, 2007, Climate Change National Adaptation Program of Action (NAPA) of Ethiopia; UN, GEF.). Analysis of the national average minimum temperature over the period 1961 to 2006 shows an evident increase trend when compared to the 1971-2000 average, as depicted in the following Figure [21]. The temperature raising trend is 0.37°C per decade.

Figure [21] - National Minimum Temperature Trend in Ethiopia (1961-2006)



Anticipated Climate Change in Ethiopia

In the NAPA report, scenario A1B-AIM was used as a reference or a "no policy scenario" and B2-MES was used as a policy scenario. Nineteen General Circulation Models (GCMs)were used to supply the SCENGEN data. The temperature and rainfall change scenarios generated are composites (averages) of these 19 GCMs.

For the IPCC mid-range (A1B) emission scenario, the mean annual temperature will increase in the range of 0.9-1.1 °C by 2030, in the range of 1.7-2.1 °C by 2050 and in the range of 2.7-3.4 °C by 2080 over Ethiopia compared to the 1961-1990 normal. A small increase in annual precipitation is expected over the country (Figure [22] and Figure [23] below).

It should be noted here that the results shown are for a mid range emission scenario.

Figure [22] - Anticipated Change in Temperature (°c)

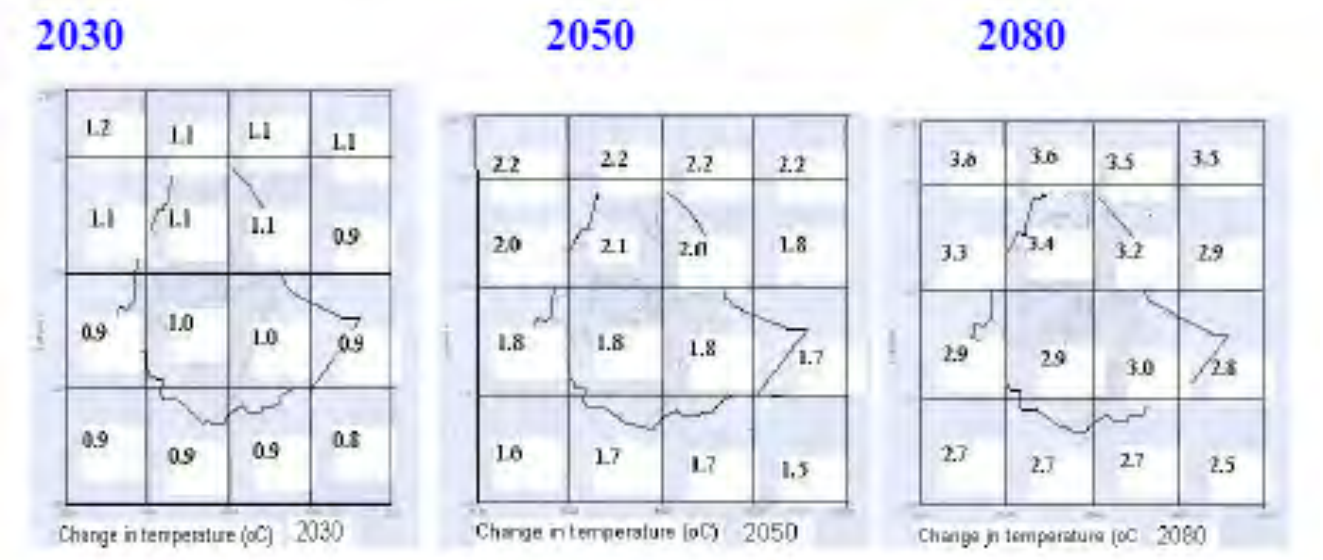
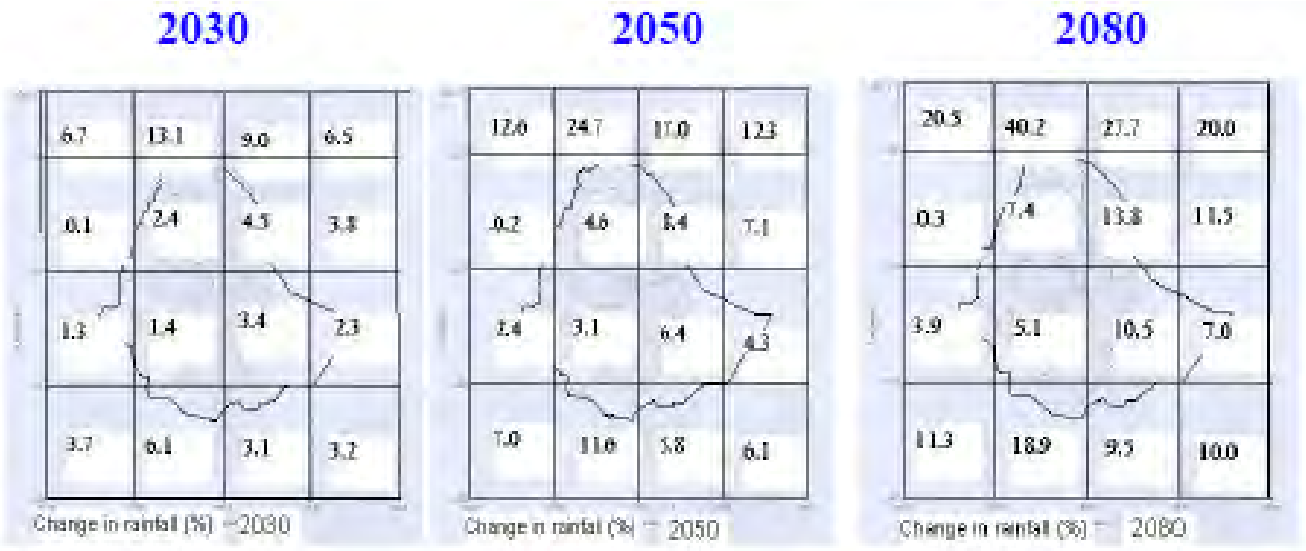


Figure [23] - Anticipated Change in Rainfall (%)



Another source of information is a recent worldwide assessment of Climate Change (CC) by country (Cline W.R.; 2007. Global Warming and Agriculture, Impact Estimates by Country. Centre for Global Development, Peterson Institute for International Economics) in which the author carries out a careful review of existing CC forecasting models and uses agricultural impact models of two separate types, the "Ricardian" statistical economic models and the process-based agronomic models, combined with leading climate model projections to develop comprehensive estimates for agricultural effects in over 100 countries.

The study develops a "consensus" set of geographically detailed estimates for changes in temperature and precipitations by the end of the century and applies these changes to the agricultural impact models.

Results on temperature and rainfall change forecasts for Ethiopia are provided on a monthly basis in the following Table [23]. Results obtained for the period 2070-2099 give a temperature increase of 4.19 °C (maximum) in June and 3.57 °C (minimum) in December. These results are slightly higher than the previous ones from NAPA report, justified by a longer term target period (2099 instead of 2080) and by simulations based on the "business as usual" scenario or the present observed trend in global warming (instead of the A1B scenario of the NAPA report which considers abatement measures in GHG emissions).

Regarding rainfall, results show a decrease of average rainfall from April to September (the wettest period) and an increase from October to March (driest period).

Table [23] - Actual and Anticipated Monthly Average Temperature and Rainfall

Parameter	January		February		March		April		May		June	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
Temperature °C	21.52	25.18	22.62	26.29	23.93	27.65	24.42	28.29	24.45	28.31	24.21	28.40
Rainfall mm/day	0.35	0.65	0.61	0.88	1.20	1.28	2.69	2.64	2.88	2.35	2.28	1.38
Region	July		August		September		October		November		December	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
Temperature °C	23.28	27.34	23.04	26.93	23.38	27.31	22.92	26.88	21.95	25.58	21.28	24.85
Rainfall mm/day	3.97	3.52	4.10	3.78	2.85	2.36	2.14	2.43	1.05	1.72	0.34	0.61

T_0: Temperature for 1961-90; T_1: Temperature for 2070-99

Impacts of CC on Agriculture

All these forecasted changes will have an effect on the future of agriculture production. The modelling exercises presented in the Cline's report consider the Carbon Fertilization criteria: Carbon dioxide (CO_2) is an input in photosynthesis, which uses solar energy to combine water and carbon dioxide and produces carbohydrates with oxygen as a waste product. In addition, higher atmospheric concentrations of CO_2 reduces plant's pores (stomates) opening and hence the loss of water to respiration. The actual benefit for the plants of higher atmospheric CO_2 depends on the plant group: C3 crops, which include rice, wheat, soybeans, fine grains, legumes and most trees, benefit substantially from additional atmospheric carbon dioxide.

C4 crops, which include maize, millet, sorghum, sugarcane show more limited benefits. Initial assessments of these benefits have been done through laboratory experiments within chambers at small scale.

Recent researches[46] based on experiments with free air concentration enrichment method (FACE) suggest that past laboratory estimates of the carbon fertilization effect have been substantially overstated[47].

The country level agricultural impact estimates presented below are based on an analysis considering carbon fertilization with an unmitigated global warming resulting in an atmospheric CO_2 concentration of 735 ppm by 2085, in accordance with the SRES-IPCC. On this basis, the central estimate of the carbon fertilization effect by the 2080s is set at 15% increase in yield, a considerably more conservative and smaller figure than results from past laboratory studies.

Optimal agricultural production has been identified at an average temperature of 11.7°C and 2.5 mm precipitation per day. At higher temperatures more precipitation is required to keep productive potential positive.

[46] Long Stephen P. & Al., 2005; Global Food Insecurity: Treatment of major food crops with elevated carbon dioxide or ozone under large-scale fully open air conditions suggest recent models may have overestimated future yields. Philosophical Transactions of the Royal Society B 360: 2011-20.

[47] In recent studies, it was found that with CO_2 elevated from 550 ppm to 575 ppm, the FACE experiment shows a yield increase of 11% for the C3 crops and 7% for all 5 major food crops, which is only one third or one quarter of the direct effect of CO_2 modeled in the early 2000s for Europe and the USA by Darwin & Kennedy. In 2006 FACE experiments, at 550 ppm CO_2, yields increase by 13% for wheat and 14% for soybean in contrast to respectively 31% and 32% in previous laboratory studies

This is the reason why developing countries, located generally in low latitudes with already an average temperature higher than this optimum will be more seriously affected by global warming than temperate industrialized countries located at higher latitude, with an average lower temperature which global warming will raise closer to the optimum, improving thus the production potential of the crops.

The forecasts have been established on the basis of the Mendelsohn-Schlesinger (MS) cross-section Ricardian model, and came to the result, for Ethiopia, of a possible agricultural capacity reduction of 53.5% by 2070-2099, taking consideration of carbon fertilization and excluding any adaptation strategy.

However, this forecast has to be put into perspective as other major factors and criteria will also impact in the long range agricultural production: uncertainty regarding the actual fertilization effect level, effects of extreme climatic events on crop growth, effects of agricultural technology improvements and extensive development of irrigation.

7.8 Impacts from Reservoir on Greenhouse Gas Emission

Sources of GHG

It has been recognized that dam reservoirs throughout the world emit Greenhouse Gases (GHG) that contribute to global warming. The GHG emissions from different dams vary greatly because the emissions are dependent on many factors and a detailed GHG assessment requires a significant amount of data from extensive field measures. Because a rather limited amount of field data is available for the Gibe III project, a simplified GHG assessment has been performed and the result should be considered as an order of magnitude of emissions.

However the approach that is used in the simplified assessment takes into consideration all the sources of GHG emissions that are studied in detailed assessments. Pragmatic and conservative assumptions have been made to ensure that the emissions are not underestimated, based on the literature and on the experience of the ESIR Consultant.

The assessment focuses on the emission of methane gas[48], produced by anaerobic decomposition of various sources of organic matter:

- Anaerobic decomposition of hard biomass (tree trunks and branches) flooded by the impounding of the reservoir;
- Anaerobic decomposition of soft biomass (grass, shrubs, leaves, fruit…) flooded by the impounding of the reservoir;
- Anaerobic decomposition of organic matter in soil (labile soil carbon) which is flooded by the impounding of the reservoir;
- Anaerobic decomposition of organic matter that is transported by the river from the catchment area into the reservoir each year;
- Anaerobic decomposition of vegetation that develops on the drawdown areas and which becomes submerged when the reservoir is filled during the rainy season.

Methodology used for GHG assessment

The assessment calculation is performed as a 6 steps process as described below. Input data and comments regarding assumptions are summarized in Table next page.

Step 1: Estimation of the total biomass present in the flooded area

The total biomass in the flooded area is the sum of the biomass for each type of carbon source. The biomass for each type of vegetation is calculated by multiplying the surface area of the vegetation by the biomass per hectare.

Step 2: Estimation of the labile carbon present in the soil of the flooded area

The labile (hydro-soluble) carbon present in the topsoil of the flooded area has been estimated by considering quantities reported in literature and making a best estimate adjustment based on expert opinion in order to reflect the specificities of the Gibe III location.

Step 3: Estimation of the organic matter that enters the reservoir from the catchment area

The organic carbon that enters the reservoir each year is estimated by considering the quantity of sediment that enters the reservoir and making an estimation of the organic content of the sediment.

Step 4: Estimation of annual biomass production on the drawdown area

The reservoir water level fluctuates over a yearly cycle between maximum and minimum operating levels. Vegetation (grasses) develops on the area exposed as the water level drops (drawdown area) and when the water level rises, this vegetation becomes flooded and decays thus contributing to GHG.

The biomass per hectare is estimated and multiplied by the surface area of the drawdown area.

Step 5: Estimation of decay rates of biomass and organic carbon

The decay rates are used to estimate the quantity of carbon that decays each year. The measurements of GHG emissions from reservoirs have indicated that the rates of decay for underwater biomass are extremely slow. The time decay constants used are presented in following Table.

Step 6: Calculation of GHG emissions

[48] CO_2 gas is highly soluble in water and only marginal quantities are released to the atmosphere, and also methane has a Global Warming Potential 25 times higher than CO_2

The GHG emissions are calculated by assuming that each ton of carbon that decays by anaerobic decomposition is converted to methane, with one mole of carbon producing one mole of methane.

Assumptions and data used in the assessment

The assumptions that are made in the assessment are as follows:

It is assumed that all the GHG emitted is in the form of methane (CH_4). The Global Warming Potential (GWP) of methane is 25, i.e. one kilogram of methane is equivalent to 25 kilograms of carbon dioxide. This is a conservative estimate because the some GHG will be in the form of carbon dioxide, however scientific literature[49] reports that for reservoirs in semi arid regions, the carbon dioxide emissions represent less than 5 percent of overall emissions.

Hard and soft biomass is differentiated. It is assumed that the dry weight of leaves, creepers, flowers and fruit (*soft biomass*) represents approximately 5% of the above ground biomass, 95% of which is made up of the trunk and branches (*hard biomass*).

It is assumed that no clearing of vegetation prior to reservoir filling is performed. This is probably conservative because clearing could be performed for economic purpose as the wood has a value in the region, due to its scarcity on the surrounding plateau areas.

The time constants for the decay of hard and soft biomass are much shorter than those reported in literature (see table below). Literature reports time constants of 500 years for hard biomass and organic matter in soil in the anoxic zone and 200 years for soft biomass. For this simplified assessment time constants of 50 years for hard biomass, 3 years for soft biomass, and 5 years for labile carbon in soil have been used. This assumption is conservative.

Regarding the growth of the biomass on the drawdown area, it is assumed that the growth will be progressive over the first few years and it will only be after 5 years that full potential for biomass development is achieved.

With respect to the organic matter entering the reservoir from the catchment area, it is assumed that organic matter is transported in the sediment and the carbon dry weight represents 1%.

Regarding the decay of the carbon in the sediment, it is assumed that the sediment accumulates progressively over the years.

Each year a new layer of sediment is deposited over the layer from the previous layer. Therefore to take into account the smothering effect, it is assumed that 10 percent of the carbon in the underlying layer from the previous year undergoes decay.

The values used in the GHG assessment are summarized in the table next page.

[49] Trembley A., Varfalvy L., Roehm C., Garneau M., (2005) Greenhouse Gas Emission – Fluxes and Processes, Hydroelectric Reservoirs and Natural Environments, Springer

Table [24] - Input data and assumptions used in the calculation of the GHG assessment

Input data	Value	Comments
STEP 1 – Estimation of total biomass present in flooded area		
Area of deciduous woodland	17,158 ha	Values taken from Gibe III ESIA
Area of Riverine forest	1,839 ha	
Drawdown area	8,000 ha	
Total flooded area	20,862 ha	
Deciduous woodland biomass density	20 tonnes /ha[50]	Review of scientific reports and publications for East African countries[51] [52] [53]
Riverine forest biomass density	100 tonnes/ha	
Drawdown area vegetation	200 kg/ha	
Total hard biomass	500,707 tonnes	Calculated from mass of carbon per hectare and total flooded area
Total soft biomass	30,152 tonnes	
STEP 2 – Estimation of the labile carbon present in the soil of the flooded area		
Labile carbon per hectare	10 tonnes/ha	Expert judgment based on work by Fernside (2002)[54]
Mass of labile carbon in flooded area	208,620 tonnes	Calculated form mass of carbon per hectare and total flooded area
STEP 3 – Estimation of the organic matter that enters the reservoir from the catchment area		
Mass of sediment that deposits each year in the reservoir	18.3 million m3 (20.13 million tonnes)	From Gibe III dam design
Organic content of sediment	1% (wt/wt)	Expert judgment
STEP 4 – Estimation of annual biomass production on drawdown area		
Drawdown area on which vegetation grows	8,000 ha	The difference between the maximum operating level and the mid depth between maximum and minimum operating levels.
Biomass per hectare	200 kg/ha	Review of scientific reports and publications for East African countries (as for step 1)
Total mass of biomass	2,400 tonnes per year	Calculated from mass of carbon per hectare and total flooded area
STEP 5 – Estimation of decay rates of biomass and organic carbon		
Hard biomass decay time constant	50 years	Assumption based on expert judgment and using work by Fernside (1995)[55] as a benchmark. The values used are more conservative than those of Fernside.
Soft biomass decay time constant	3 years	
Organic matter in soil decay time constant	5 years	
Organic matter in sediment decay time constant	200 years	
Decay rate of vegetation on drawdown area	50% decays each year	Assumption based on work by Rosa et al (2002)[54,56].

Note: All weights are expressed as dry weights, with carbon content equivalent to 90% of dry weight.

[50] All weights expressed as dry weights of organic matter

[51] *Vegetation cover assessment in Turkana Districy*, Kenya by Moses Ooro Olang, Kenya Rangeland Ecologoical Monitoring Unit

[52] Biomass Density Estimates of Developing Countries Based on Existing Inventories, FAO

[53] Deshmukh, I. (2008) Estimates of Woodland Biomass in the Juba Valley, Southern Somali, And Its Application to East African Rangelands, African Journal of Ecology, volume 30, issue 2, pages 127-136

[54] Fernside, P. M. 2004 – *A framework for estimating greenhouse gas emissions from Brazil's Amazonian hydroelectric dams*. National Institute for Research in the Amazon (INPA), Manaus-Amazonas, Brazil

[55] Fearnside, P.M. (1995), Hydroelectric Dams in the Brazilian Amazon as Sources of Greenhouse Gases, Environmental Conservation, v.22(1), p. 7-19

[56] Rosa, L.P, et al (2002, Hydroelectric Reservoirs and Global Warming, World Climate and Energy Event

Results of the GHG Assessment

Emissions from Gibe III Reservoir

Results of GHG emission from the Gibe III reservoir are provided in the Table [25], Figure [24], Figure [25], and Figure [26] below. Calculations have been performed over a 30 year period, with and without pre-impoundment clearing. Clearing option considered for the computation considers:

- Total clearing of the riverine forest, no clearing of the deciduous woodland forest;
- Maximum biomass abatement of 80% for hard biomass and 90% for soft biomass, only applicable to the riverine forest.

A significant amount of GHG produced the first 5 to 10 years comes from the rapid decay of the soft biomass flooded. Clearing of the alluvial forest will mainly impact this source of emission.

Table [25] - GHG Emissions from Gibe III Reservoir

	Without Vegetation Clearing	With Vegetation Clearing
Annual Average 30 Years ('000 t/yr)	112	94
Annual Average Years 1-10 ('000 t/yr)	164	135
Annual Average Years 11-20 ('000 t/yr)	91	76
Annual Average Years 21-30 ('000 t/yr)	82	69
Cumulative Emission 30 Years (Million Tons)	3.37	2.81
Cumulative Emission Years 1-10 (Million Tons)	1.64	1.36
Cumulative Emission Years 11-20 (Million Tons)	0.91	0.76
Cumulative Emission Years 21-30 (Million Tons)	0.82	0.69

Figure [24] - Annual GHG Contribution of the Various Types of Emission Sources (no Clearing)

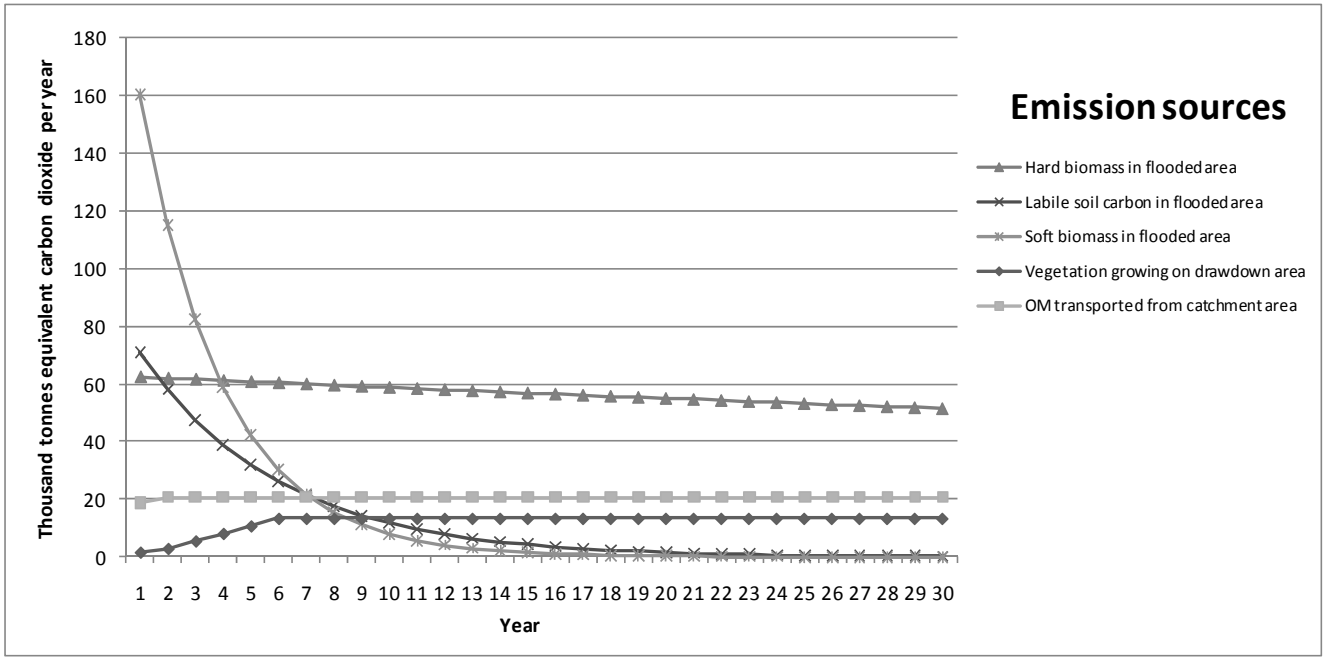


Figure [25] - Annual Combined GHG Production of Emission Sources (No Clearing)

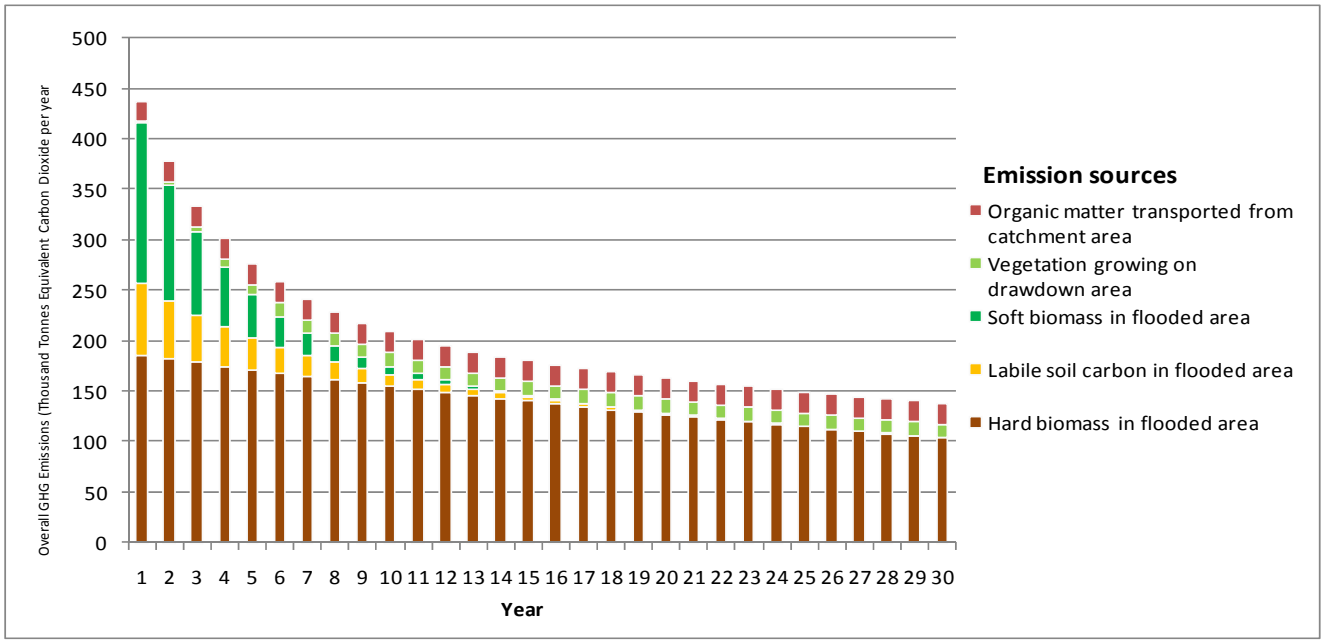
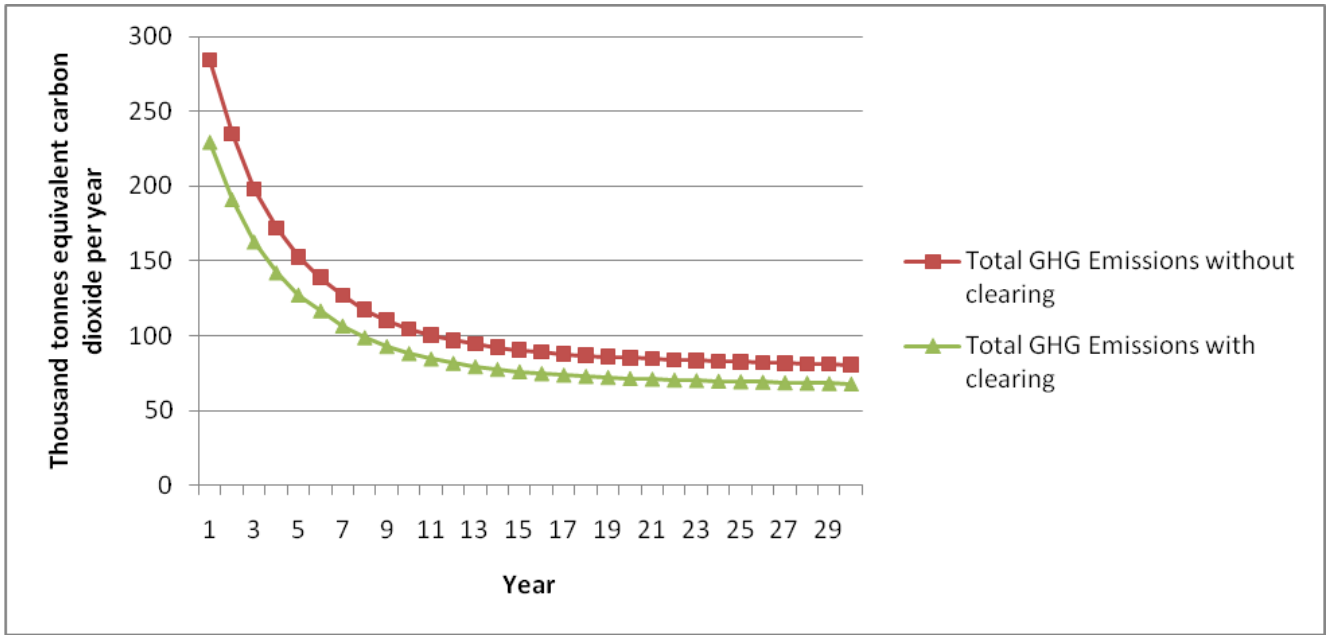


Figure [26] - Reservoir Annual Emissions with and without Clearing of Riverine Forest



Comparison with Alternative Sources of Energy

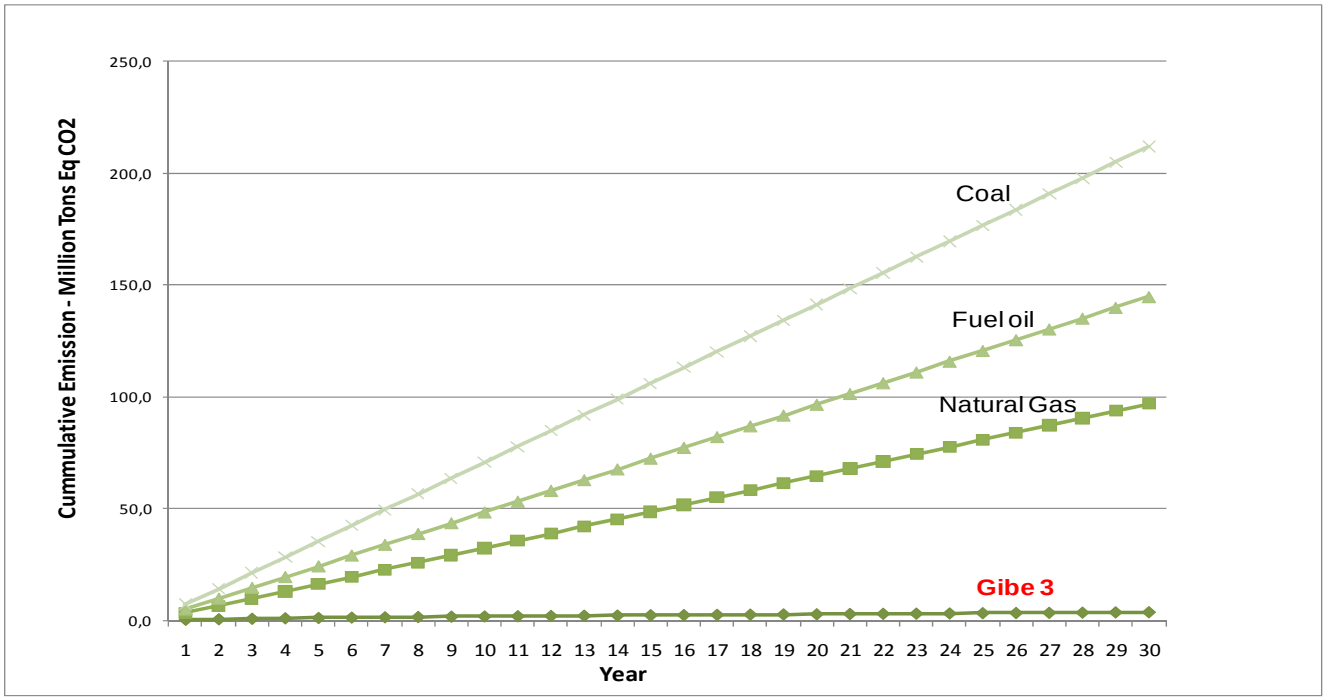
The GHG emissions from Gibe III reservoir are compared with GHG emissions from thermal alternatives with a similar installed power generating capacity.

The basis for calculating the GHG emissions for the thermal power plants is as follows:

- The method used for calculating emissions is that described in the *World Bank Greenhouse Gas Assessment Handbook, 1998*;
- The plant capacity is 6,400 GWh per year
- The fuel requirements for oil, gas and coal are respectively 6.58 x 10^4, 5.76 x 10^4 and 6.98 x 10^4 Terajoules per year (TJ/yr);
- The assumed plant conversion efficiencies used are 35% for fuel oil, 40% for gas and 33% for coal;
- The carbon contents for the fuels are: 20, 15.3 and 27.6 tons of carbon per TJ for fuel oil, gas and coal respectively;
- The emission factor for converting tons of emitted carbon to tons of emitted carbon dioxide is 44/12.

The results presented in the following Figure [27] show the evident benefits from the hydropower when compared with thermal generation.

Figure [27] - Comparison of GHG Emissions from Alternative Power Generation



Comparison with Other Dams Worldwide

Over 30 years, the Gibe III will generate an estimated average of:

- **539 g eq CO2/m²/year** (no pre-impoundment clearing) or
- **449 g eq CO2/m²/year** (with pre-impoundment clearing)

The figure below shows the position of Gibe III compared to other dams in Brazil, Canada and Finland.

Figure [28] - Comparison of Gibe III Average GHG Emissions with Other Dams

Source: World Commission on Dams (except for GIBE III data)

7.9 Eligibility of Gibe III to CDM

The CDM Framework

The central feature of the Kyoto Protocol is its requirement that countries limit or reduce their greenhouse gas emissions. By setting such targets, emission reductions have taken an economic value. To help countries meet their emission targets, and to encourage the private sector and developing countries to contribute to emission reduction efforts, negotiators of the Protocol included three market-based mechanisms – Emission Trading, the Clean Development Mechanism (CDM) and Joint Implementation.

The CDM allows emission-reduction (or emission removal) projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one ton of CO_2. These CERs can be traded and sold, and used by industrialized countries to meet part of their emission reduction targets under the Kyoto Protocol. The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction limitation targets. Operational since the beginning of 2006, the mechanism has already registered more than 1,000 projects and is anticipated to produce CERs amounting to more than 2.7 billion tons of CO_2 equivalent in the first commitment period of the Kyoto Protocol, 2008–2012.

The proposed projects must qualify through a rigorous and public registration and issuance process designed to ensure real, measurable and verifiable emission reductions that are additional to what would have occurred without the project.

The mechanism is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol. In order to be considered for registration, a project must first be approved by the Designated National Authorities (DNA).

CDM Eligibility Criteria

The Marrakech Agreements define several criteria for the eligibility of a project to the CDM:

Environmental Criteria

Eligible GHG: the Project must effectively reduce one or several of the 6 eligible GHG which are CO_2, CH_4, N_2O, HFC, PFC and SF_6.

Additionality: This is a key criterion, which imposes that the emissions reduction of the project must be additional to the emissions reduction which would have been observed without the project. CDM is not implemented to accompany "business as usual" projects. It is necessary to demonstrate that there is one or several barriers (investment, technological, prevailing practice barriers), that would prevent the implementation of the project activity from being carried out if the project activity is not registered as a CDM activity, and also that the identified barrier(s) will not prevent at least one alternative to the project to be implemented.

Environmental Impact Assessment: The proposed project must be free of detrimental impacts on the environment. If environmental impacts are anticipated, an EIA will be required.

Institutional Criteria

Project Approval by the host country.

Compliance with national policies and strategies: the project must contribute to the national development objectives of the host country and promote technology transfer.

Dedicated Institutional Capacity: The host country must (i) have ratified the UNCCC, (ii) have ratified the Kyoto Protocol, (iii) have designated a focal point for negotiating at national level the implementation of UNCCC and Kyoto Protocol, (iv) have implemented a designated national authority for the CDM.

Specific criteria applicable to Hydropower

The Executive Board of UNFCCC's Clean Development Mechanism has introduced criteria for hydro project applications (called Annex 5). The criteria are based on thresholds in terms of power density (expressed in Watt/m², corresponding to the installed power generation capacity divided by the flooded surface area) as follows:

- Projects with power densities less than or equal to 4 W/m² are excluded;
- Projects with power densities greater than 4 W/m² but less than or equal to 10 W/m² can be eligible, but with an emission penalty of 90 g CO2eq/kWh;
- Projects with power densities greater than 10 W/m² can be eligible, without penalty.

However, these criteria have been criticized by the IHA which considered them as too limitative and excluding, de facto, most of the hydropower projects from eligibility[57].

The EU Linking Directive

Large hydropower projects are eligible to create emission reduction credits (CERs) under the Kyoto Protocol's Clean Development Mechanism. Conscious of criticism toward hydroelectric projects, the EU has attempted to regulate the use of CERs and Emission Reduction Units ("ERUs") from large hydro projects under the European Union Emissions Trading Scheme (EU ETS). For that purpose, EU Member States have imposed potential limitations on recognizing CERs generated from hydropower projects above 20MW and the impact of this upon the transferability and tradability of such Hydro CERs, taking into account the applicable EU legislation and existing international guidelines for the development of hydropower projects.

The Directive 2003/87/EC[58] establishes the main rules and procedures of the EU ETS. This Directive was later amended by Directive 2004/101/EC (the so-called "Linking Directive")[59]. The Linking Directive regulates the use of project-based credits from the Kyoto Protocol within the Community scheme and introduces conditions for the use of CERs and ERUs for compliance under the EU ETS.

Article 11a(6) of the Linking Directive allows the use of credits from hydroelectric projects with a capacity of less than 20 MW, but imposes additional qualitative restrictions on approval of hydro projects with a capacity of more than 20 MW for the generation of CERs. The Linking Directive states:

[57] IHA estimated that the criteria would inappropriately exclude the majority of hydropower projects from the CDM, indicating that a power density of 4 W/m² was well above the international average for hydropower, while the vast majority of the gross GHG emissions from reservoirs were significantly lower than 90 g CO_2eq/kWh. IHA argued also that gross emissions did not subtract emissions that would have occurred naturally, and that emissions would have occurred with or without the inclusion of a hydropower scheme. According to IHA, the CDM criteria grossly overestimated the contribution of greenhouse gas resulting from hydro generation.

[58] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a Scheme for

Greenhouse Gas Emission Allowance Trading within the Community and Amending Council Directive 96/61, OJ 2003

L275

[59] Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive

2003/87/EC establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community, OJ L338

13.11.2004, p. 18–23 (hereinafter "Linking Directive")

In the case of hydroelectric power production project activities with a generating capacity exceeding 20 MW, Member States shall, when approving such project activities, ensure that relevant international criteria and guidelines, including those contained in the World Commission on Dams November 2000 Report 'Dams and Development — A New Framework for Decision-Making', will be respected during the development of such project activities.

The Linking Directive also introduces the obligation to include in the ETS revision process, set forth under Article 30 of Directive 2003/87, an evaluation of approved CDM hydro projects with generating capacity above 500 MW and of the future use of CERs resulting from any such projects in the Community scheme (Article 1.8(b) of the Linking Directive).

The Linking Directive, therefore, does not exclude the use of CERs from large hydro projects, but only shifts the responsibility for verifying the quality of certain projects (and thus of the credits originated by such projects) to the Member States.

As discussed in a dedicated section of this report, the 2000 WCD's guidelines do not establish a framework to test the quality of existing hydropower projects but instead are intended to set forth strategic priorities and principles to guide the decision-making process in the development of large dams. The WCD guidelines are not an international legal document. However, through the inclusion made by the Linking Directive, the WCD guidelines have acquired legal significance at the EU and Member State level. The ETS Linking Directive makes no distinction between types of hydro plants. It merely defines a threshold (set in accordance with plant's generation capacity) above which the WCD's guidelines have to be observed.

Opinion on the Eligibility of Gibe III to CDM

The ESIR Consultant appreciation of potential eligibility of Gibe III to CDM is summarized in the Table [26] next page.

Eligibility for the Gibe III Project may be difficult to achieve mainly regarding the justification of its additionality considering (i) its high installed capacity, (ii) the project construction started 3 years ago and (iii) that hydropower is already the main source for electricity in Ethiopia.

Regarding the third constraint, an alternative approach could be considering the present status of energy production in Kenya, as most of the production from Gibe III will be exported there. However, it may also be difficult to justify the additionality as presently 65% of electricity in Kenya is provided by hydropower (11 plants and 56%) and by geothermal (3 plants, 9%). Kenya is presently also considering wind farming, with a major development project in Lake Turkana region of 300 MW total installed capacity[60].

[60] Objective is 360 wind turbines with full capacity reached by 2012. Total cost is 760 MUS$, 30% financed by the ADB.

Table [26] - Potential Eligibility of Gibe III to CDM & Linking Directive

Criteria	Gibe III Situation	Eligibility
Institutional Criteria		
Project Approval	Project developed by the Government of Ethiopia	Yes
Compliance with Policies and Strategies	Project developed by the Government of Ethiopia	Yes
Ratification UNCCC	Signature 10/06/92 Ratification 05/04/94 Entry into force 04/07/94	Yes
Ratification Kyoto	Signature: Not yet Ratification 14/04/05 Entry into force 13/07/05	Yes
Focal Point	Ministry of Water Resources / National Meteorological Agency	Yes
Designated National Authority	Same as above	Yes
Environmental Criteria		
GHG concerned	CO_2 & CH_4	Yes
Additionality	Hydropower is not a new practice in Ethiopia	Difficult to justify additionality
	Hydropower and geothermal already developed in Kenya, wind farming on track	Difficult to justify additionality
	Difficult to consider the project is not feasible without CDM	Difficult to justify additionality
	Installed capacity of 1,870 MW much higher than highest HPP in the world elected to CDM (less than 250 MW)	Justification uncertain
Environmental Impact Assessment	Documentation existing and approved by EPA	Yes
Hydropower Criteria (Annex 5)		
Power Density limitation	1870 MW installed capacity for 209 km² reservoir at MOL, or a Power Density of 8.86 W/m²; value within 4 and 10 W/m²	Yes (with emission penalty from reservoir of 90g CO_2 eq/kWh)
EU Linking Directive		
Compliance with WCD principles	Compliance with WCD principles is still limited	Difficult without improvements
	Additional evaluation required because project above 500 MW	??

Chapter 8. Review of Social Impacts and Mitigation

8.1 Impacts from Reservoir

Potential for Reservoir Fisheries

Gibe III dam will create a reservoir of 209 km², with a length of 200 km at an average altitude of 850 m above sea level. Inside that part of the Omo River, the number of species may be close to 20, and some of them will benefit from the lotic (lacustrine). Whatever the potential of the reservoir, the dam being constructed in an area where human population density is presently very low, the issue will be to exploit this potential. In Gibe I reservoir, completed in 2004, the fishery activity started with young men (18-25 years) with no specific experience but who gradually acquired hooks, nets and small embarkations and make now their living on catching mainly Tilapia and a few Barbus species. In the absence of a fisheries development programme to attract fishers, the same scenario could appear in Gibe III reservoir.

Species

The species trapped by the dam will modify their behaviour and migration downstream will no be possible. As a result some species will gradually disappear when others will find suitable conditions to develop and occupy the niches created by the reservoir. Cichlids like *Tilapia, Oreochromis* and *Sarotherodon* will gradually occupy most of the niches, mainly on the shore line and in shallow waters. Clariidae will also find suitable conditions and reproduce when the water level rises from July to September. Mormyrids (elephant fish) will probably disappear. Centropomidae (Nile perches) will have good conditions for development, but it will be necessary to carry out fishing tests after the dam is commissioned to ascertain their presence in this part of the Omo River. The same issue arises for the *Distichodus* which may not be present now, but which could find suitable conditions. Barb species which normally are present in the upper Omo River will also find good conditions, even if the migration upstream will be somehow hampered by the Gibe I dam. As a result the situation encountered in Gibe III will be similar to the one in Fincha reservoir and in Gibe I: the water in Fincha reservoir is warmer than in Gibe I and Gibe III because of the altitude, and over the years the dominant species is at present *Tilapia zillii,* which could represent more than 80% of the annual catch.

Exploitation of the potential

Gibe III is being erected in an area where population is scarce, hence the estimated fish catch potential - close to 485 t/year - may not be exploited if only few fishers are inclined to move and make their living in a region presently inhabited. It is recommended, as a mitigation measure of the creation of Gibe III reservoir, to prepare a **fisheries development programme**, including information for the population of the Omo region, fishing tests once the dam in operation, and facilities to create a fishermen village on a suitable place (access road, electrification, drinkable water, etc.).

In order for the fishers to have a decent revenue (an average of 1000 birr per month is considered as good in 2010), it is anticipated that **150-180 professional fishermen** could make their living in the reservoir during the first years after commissioning the dam. This number would increase over the years whenever the anticipated situation of the fish stock evolves towards a higher potential, following the introduction of commercially interesting species (*Distichodus, Heterotis niloticus,* among others) and the living conditions in the vicinity of the reservoir are proper for fishers' families.

The introduction of additional species is not an easy task, and will be especially difficult in the context of Ethiopia where the fry to be carried to Gibe III reservoir will have to come from the wild (there are no fry production stations in Ethiopia). A fisheries management plan will have to investigate the possibilities to catch fry and to carry it with proper equipment (van with oxygen supply). Should the introduction of species in the Lake be considered, it will be done using exclusively species already observed in the Omo River or in Lake Turkana, in order to avoid potentially hazardous introduction of alien species in the river system. Artificial introduction of species could be considered to diversify the fisheries products put on the market and increase the reservoir production by the use of some ecological niches (habitats) in the reservoir which may be not utilized by the various species listed above. Additional investigations in this field are recommended within the framework of a comprehensive fisheries development plan.

Commercialisation

In the present situation, as it has been observed at Lake Turkana and at Gibe I reservoir, fishers sell their catch to enterprises which purchase filleted fish (*Tilapia, Lates*) and dried fish (mainly *Tilapia* and *Heterotis*) for sale in Addis Ababa and export to Kenya, respectively.

Three enterprises purchase the products from Lake Turkana: Fish Market Company, Ethiofish Co. and Omo River Trade Co.; and one private entrepreneur buy fish at Gibe I. The three companies at Lake Turkana also work in other water bodies, mainly the natural lakes of Chamo and Abasa and sell the produce in the capital (retailers and hotels/restaurants).

The main difference between Gibe I and Gibe III is the existence of a town (Sukoru) close to Gibe I: as a result people living in the city and in the close-by villages can easily get access to the fishing grounds and sell their production to the local entrepreneur who possesses a grocery shop, a freezer and transportation facility (refrigerated van). No town exists close to the reservoir (the closest city is Sodo, 2 hours off the dam), and the creation of jobs will be subject to a settlement plan including common facilities.

Inundation of Grazing Land and Obstruction of Crossing Points

Impacts from reservoir flooding outside the three woredas of Lome, Kindo Didaye and Kindo Koysha are not listed in the RAP Chapter 6 (Impacts of the Project). However, in Section 9.3 (Community and Social Development Plan and Strategies) impacts are recognized – and addressed. These impacts include:

- Livestock in the woredas surrounding the future reservoir will potentially be affected by tsetse flies as well as internal and external parasites.
- The reservoir will flood an estimated 17,158 ha of wood and grassland, representing in average 5% of the wood and grassland in the affected woredas. Hence, the communities will not be severely affected by this impact.

Crossing the Omo River serves an important purpose for communities along the future reservoir, especially for marketing of agricultural products as people from the more densely populated left bank of Omo River at times of low water levels travels across the river to purchase food products in the more food abundant / less densely populated right side of the river[61]. Other purposes include searching for grazing land (especially the Hadiya ethnic group) and visiting relatives. No numbers of people affected by this impact is provided but the impact is considered to be very significant and includes in particular Dawro, Wolayta, Hadiya, Kembata, Tembaro and Oromo people.

Public Health

The potential health impacts for the reservoir area and construction sires are well identified in the RAP[62]. These include water related diseases (i.e. malaria, bilharzia), increased prevalence of HIV/AIDS/STIs and increased pressure on health services from the contractors work force.

The former two risks are genuine but require further investigation, whereas the latter probably is exaggerated as the contractor provides health services to all employees and even to some extent to the surrounding communities.

The anticipated health impact in the downstream area is mainly positive: The controlled flow is expected to reduce the extent of swamps created by the natural floods and thereby eliminating the breeding ground for waterborne diseases (especially malaria)[63]. However, the ESIA-DS is also warning that some water-related compensation measures (e.g. irrigation and flooding of forest or grassland) could lead to increased breeding ground for water borne diseases, if not dealt with by experienced people.

8.2 Impacts from Chida-Sodo Road and Transmission Lines

Chida-Sodo Road and Employers Permanent Camp

Due to the future flooding of the Chida-Sodo Road, a new road was proposed, which follows the future reservoir on its left bank away from most populated areas (see Figure [29]). However, during consultations in Kindo Didaye and Kindo Koysha Woredas people complained about not being able to benefit from the opportunities the new road would offer, e.g. market outlets, transport, social infrastructure. EEPCO subsequently agreed to let the road pass through the more populated areas with the higher cost for resettlement compensation this would entail. The road in the current alignment will affect 783 households including 123 residential houses (see Table [27] below).

The Employers Permanent Camp is located on a hill top, a few hundred meters from the realigned road in Kindo Didaye Woreda and measures approximately 20 hectares. Hence it will affect 18 residential houses and the land of 51 households.

The impacts from the future reservoir, along the Chida-Sodo Road realignment and at the Employers Permanent Camp are well defined and documented in the RAP (December 2009).

Transmission Line and Sub-station

A 400 kV Transmission Line will be erected to connect the Power Station with a sub-station to be built outside Sodo. The main impact is on the houses of 177 households, who will have to relocate their house but fortunately can do so within their own residential land. Other impacts relate to farm land, crops and trees but this is relatively marginal for each household.

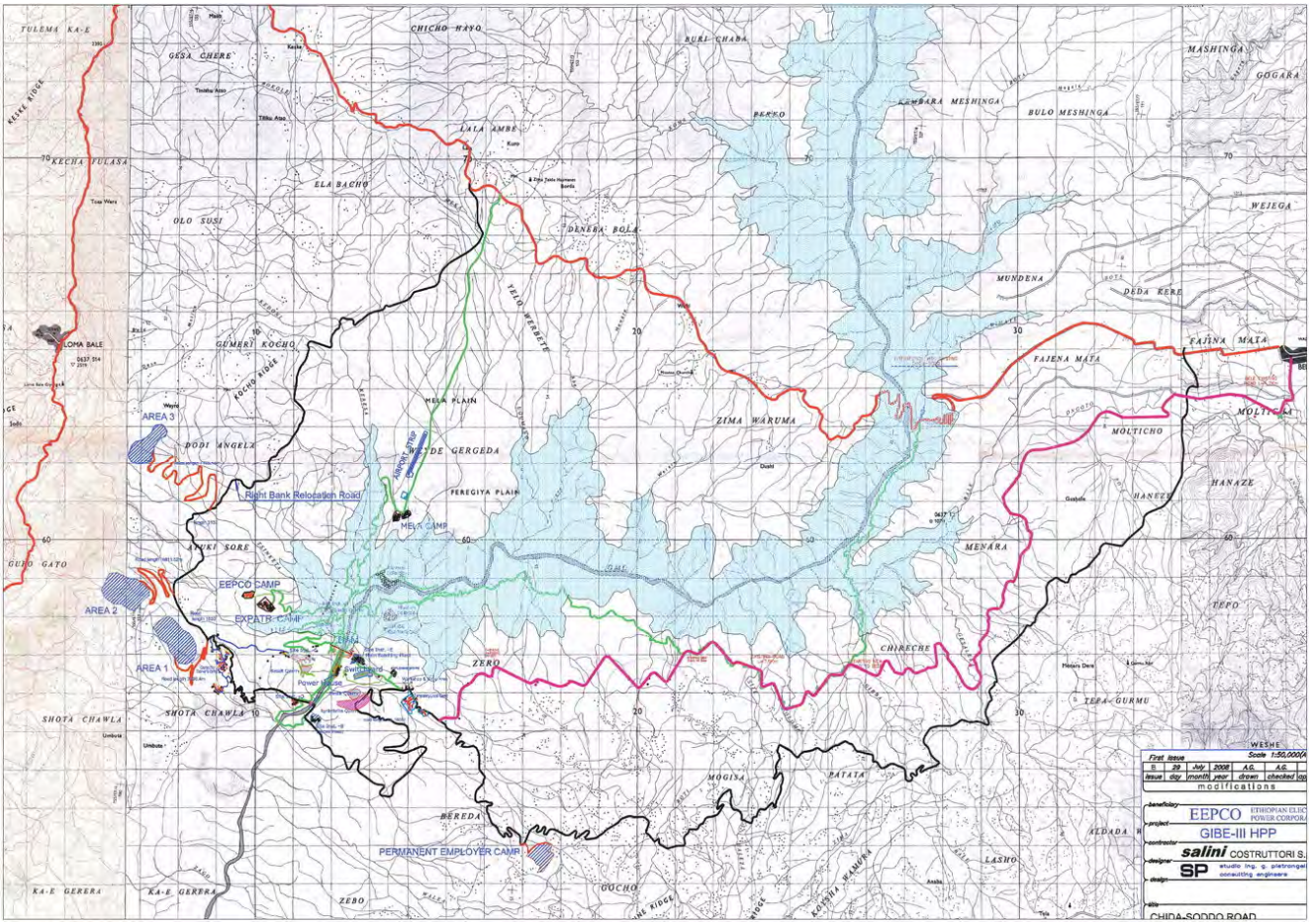
The ESIA-TL and RAP-TL do not present the actual location of the transmission line and sub-station outside Sodo, either with coordinates or a map.

61 RAP, Section 9.3.8.

62 See RAP, p. 129-30.

63 See ESIA-DS, p. 140-41.

Figure [29] - Map of the relocation of the Chida-Sodo Road



Legend for roads: Red: current roads. Green: access roads (EPC). Pink: original plan for realignment of Chida – Sodo Road. Black: Current plan for realignment of Chida – Sodo Road.

Table [27] - Impacts from reservoir, Chida-Sodo road and permanent Employers camp on houses & lands

	No. of HHs	Land affected (ha)		No. of residential houses	No. of perennial crops / trees affected
		Total land	Farm land		
By Woreda					
Kindo Didaye	537	108.04	73.19	99	138,944
Kindo Koysha	214	30.51	18.96	30	32,355
Loma	141	87.37	56.22	12	12,885
Total	892	225.92	148.37	141	184,184
By Project Component					
Reservoir	58	92.92	70.14	0	6,523
Chida – Sodo Road realignment	783	111.87	72.10	123	139,374
Permanent Employers Camp	51	21.14	6.13	18	38,287
Total	892	225.92	148.37	141	184,184

Source: RAP, December 2009.

8.3 Downstream Issues

Recession Agriculture

The construction of the Gibe III dam will have significant and direct impacts on the reduction of cultivated land on the river banks and flooded areas (recession agriculture). Whereas river banks will not be saturated without the controlled flood, the flooded areas behind the river banks will typically not even benefit from the controlled flood as it is designed in the ESIA-DS. However, more details concerning cultivated areas and productions at Kebele level are required in order to assess and locate the project impacts on the future food availability.

In order to allow the continuation of flood recession cropping, a controlled discharge from the reservoir (10-day artificial flood) is envisaged between August and September. This release will be intended to limit downstream flooding to the required extent, both in duration and area, while reproducing the natural average flooding conditions.

It is actually not possible to evaluate the effectiveness of such a mitigation measure without a scientific detailed survey which will determine what is required to obtain successful results from flood recession cultivation.

For the Africa Resources Working Group (ARWG - A Commentary on the Environmental, Socioeconomic and Human Rights Impacts of the Proposed Gibe III Dam in the Lower Omo River Basin of Ethiopia- January, 2009) "such flood simulation has not been extended or effective in Sub - Saharan Africa, ... Although described as a definite component of the proposed Gibe I program, it is a fact that there is no case of successful implementation of downstream flooding within Sub -Saharan Africa."

Rainfed Agriculture

There will be no adverse effect on rainfed cropping areas, but the risk of erosion and soil losses will increase in these areas in case the main measure (controlled floods) do not achieve the expected results.

Irrigated Agriculture

No adverse impact is anticipated for irrigated agriculture. In fact, this will be the main beneficiary from the reduced flooding. At present, pumping station sites near the river are frequently damaged by floods, and then private farmers and governmental institutions are not investing in permanent infrastructures. As a result most irrigation is limited to low capacity portable pumps.

Pasture Lands

Of the almost 100,000 ha of pasture lands in the four woredas concerned, a significant part is situated in the delta of the Omo River and depend on the natural fluctuations of the Omo River, Lake Turkana and oxbow lakes.

Without mitigation measure, the dam would reduce the natural fluctuation of the lake and river, which would reduce the amount of rangelands available. This may adversely affect the pastoralists using these spaces for their cattle, especially the Dasenech.

The dam may also decrease the level of the Lake Turkana and displace it southwards by more than 10 km, i.e. towards Kenya, which might increase conflicts between the Dasenech and the Turkana living on the other side of the border. Additionally, as the salinity of the Lake Turkana is high, grazing land exposed might not be of a very good quality and/or potentially be reduced in area. This has been observed by the ESIR Consultant around the Ado Lake in the delta (Dasenech Woreda), where vegetation and grazing lands are scarce because of the salted nature of the soils.

Fisheries

The fisheries activity is at its minimum when the discharge in the Omo River is low. The present dry season discharge of about 200 m3/s will increase with the dam operation to 500 m3/s and above depending on the reservoir operation. This will allow bigger fish from Lake Turkana to stay longer in the river. This will probably be the case for the Nile perch (*Lates niloticus*), *Distichodus niloticus*, Barb species, and *Clarias gariepinus*.

At present, during wet season flow, fishing activity is normally difficult, the flow carrying wood debris and the velocity may damage the gear or take it away. When the discharge from Gibe III will be around 700 m3/s during the rainy season, fishing conditions will be much better. The discharge increase will trigger off the migration of species which start their reproduction cycle upstream like Nile perch, *Clarias sp.*, *Distichodus sp.*, and barb species. As the flow will not reach the minimum levels as observed presently, the fry will find better conditions in terms of feeding and movement.. The improved water quality (less sediment load) will also provide better conditions for the fry with more algae and plankton development.

At present, the limited flow in the river during the dry season (less than 30 cm observed in January 2010 by the ESIR Consultant 3 km downstream Omorate) is evidently a major limitation for big fishes to remain in the river after the rainy season. With Gibe III, adult fish may stay longer in the river before returning to the Lake Turkana, and thus offering better opportunities for river fisheries.

The Nile perches of 30-50 kg are generally not caught at present by the fishermen of the Omo River, as they don't have the proper equipment and gear (big mesh size nets, as those used in Lake Turkana). Training and availability of appropriate gear could be an objective for future development of fisheries in the Omo River.

More fishing in the lower Omo may replace less fishing in the Lake Turkana. Indeed, the anticipated drawdown of the lake level, even limited, will move further south the lake shore, closer to the Ethiopia-Kenya border, limiting the possibilities for Ethiopian fishermen to expand their activity in the lake.

Along the Omo north of Omorate, many oxbow and meander lakes are observed which provide important fisheries resources for the local population. The most well known lake of this type is the Dipa Lake near Kara Korocho. These lakes are favorable for extensive aquaculture of Clarias and Tilapia. The proposal to create controlled flooding (or other downstream infrastructure for the seasonal raising of the river water level) will be beneficial for the yearly filling of these lakes, should some additional intake facilities be implemented where necessary.

River Crossing

The Omo River is traversed mainly by boat but at times with particularly low water levels, people may cross the river by foot, and at times herding their livestock. The regulation of water flow will lead to a higher water level in the dry season and crossing by foot will henceforth not be possible.

Daily fluctuations from operation of the Gibe III Dam will furthermore lead to increased potential danger, especially within the first 200 km downstream of the dam. This area is not populated but people from villages nearby or further away may approach the river for different usages or for crossing it.

Trade, Prices and Food Sufficiency

The ESIA-DS mainly focuses on formal trade, which is very little developed in the four woredas. There is no market structures even at the towns where exchange of goods does take place, and inter-woreda exchange is very limited, mainly due to very poor transportation infrastructure. Development agencies could substantially boost inter-woreda or inter-regional commercial exchanges, especially of fish and meat: introducing microcredit, building roads, bridges and a slaughterhouse, etc. Regulating the river flow could improve navigation and may have a beneficial effect on this kind of trade.

However, very little is mentioned in the ESIA-DS about daily, informal trade, an important part of people's lives. Indeed, animal products like butter and milk, as well as livestock itself, are currently exchanged in towns (such as Omorate, Turmi, etc.) against food, coffee husks, or money. Coffee husks are sometimes resold to villagers with small profits. Sorghum is also sold when there are surpluses. Other people also collect fuelwood and sell it to the townspeople. There is also an informal transboundary trade system with Kenya and Sudan, for instance livestock selling in Kenya versus soap and clothes resold in Ethiopia. Some traders especially come from Addis Ababa, Arba Minch and Jinka to buy these products in the region.

These products are not independent from the market economy. Both food and animals have a price which may fluctuate according to demand and supply – when there is abundance of sorghum, prices drop; when there is scarcity, prices raise to high levels, which may affect the survival of entire pastoral communities, as livestock prices do not raise with the same rate.

When droughts occur, the animals tend to produce less, be thinner and more ill, which influences their market value and consequently the amount of food the owner can get from the same number of animals.

As the daily diet of both pastoralists and agro-pastoralists highly depends on sorghum and livestock, price fluctuations may adversely affect the entire population. Without mitigation measure, the dam would affect recession agriculture and thus food prices would tend to raise. In that case, more cash or livestock would be necessary to buy the same amount of food, with serious consequences in terms of food security, even for the "pure pastoralists". Food and livestock price monitoring appears necessary, together with mitigation measures in case of significant impact.

Culture

The people of the lower Omo have developed a remarkable cultural and social system, which includes traditional medicine, astronomy, social safety nets and specific land uses. There is increasing interest in this system as well as recognition of its value. However, impacts of the project on indigenous culture are overlooked in the ESIA reports. At present, a significant part of the culture of the ethnic minority groups living downstream is related directly or indirectly to the Omo River. Pastoralist lifestyle could be affected by a reduction of grazing lands in the river delta if no mitigation measures were undertaken. Agro-pastoralist lifestyle could be threatened by a reduction of recession agriculture. Moreover, the development of irrigation schemes as mitigation measures could induce a settlement of pastoralist population and reinforce the decreasing trend of pure pastoralism. Attention should be paid to these aspects, and appropriate monitoring measures undertaken, especially towards pastoralists. On the other hand, their culture is neither static, nor impeding innovations. It has the capacity to evolve and adapt to current challenges. The shift towards agro-pastoralism is widespread, and most agro-pastoral communities visited by the ESIR Consultant expressed the wish to shift from recession agriculture to irrigated agriculture in order to sustain themselves, provided they get proper support, without entirely losing their pastoral values.

The development of tourist activities induced by the increase of navigation potentialities in the Omo River, or by mitigation measures, could also affect the socio-cultural patterns of the population, if not introduced smoothly and with great care. The influx of big amounts of cash, previously unknown, may induce social inequalities if not managed properly by the community. It could also disrupt livelihood patterns, with no certainty that income from tourism would be sustainable. Ethno-tourism may also induce an exaggeration of the most spectacular part of people's traditions or peculiarities, becoming mere objects of income instead of a vivid part of their daily social organization. Tourist development is thus recommended by the ESIR Consultant as mitigation measure for livelihood improvement, provided implementation efforts ensure an appropriate integration within the current social system of the beneficiaries.

Tourism

As there is no major tourist attraction in the reservoir area, its impoundment is unlikely to affect touristic activity. However, the realignment of the Chida-Sodo road will partially flood two historic walls which could become tourist attractions. The mitigation measures outlined (See p 48 and Appendix 13 point 15) are likely to increase tourism related to this site.

On the other hand, the stabilization of the flow of the downstream of the Omo River brought about by the dam would increase its navigability and thus its potential tourist use for access or recreation. Moreover, some of the mitigation measures, livelihood improvement and local development activities related to the project will probably increase tourist activities downstream.

Therefore, it is likely that the impact of the hydropower scheme on tourism in the affected areas would result in an increase of tourism activity. Precautions and specific measures are to be taken in order to avoid a detrimental effect on the local ethnic group's lifestyle (see above) as well as on the biodiversity. If properly controlled, implemented and managed in collaboration with local populations, the increase of eco-tourism development after the dam completion could be a great opportunity to combine cultural development, livelihood improvement and biodiversity conservation.

Gender

Impacts on livelihood activities will affect men and women in different ways.

Livestock is mainly kept for banking the family's fortune and to keep for leaner times. It also reflects to the fellow villagers and outside world the wealth of the family. Livestock herding is the responsibility of men and boys to the extent that women even do not have a say in whether to sell or slaughter an animal. The impact on pasture land is mainly limited to certain areas of Dasenech Woreda. To the extent that the fishery will develop, this will mainly be a benefit to the men, who are engaged in fishing and processing and trading of fish. Farming is a shared responsibility of male and female members of the household, although women bear the main part of the workload. It is usually also the responsibility of the woman to ensure food preparation. Impact on the recession agriculture is therefore primarily an impact on the women who have to make up for the loss of agricultural output. The impact on recession agriculture will take place in the entire downstream area but is increasing towards the lower parts of the zone where more land traditionally is subjected to seasonal flooding.

People's Vulnerability to Drought and Floods

It appears evident from the baseline analysis that without mitigation measure, the dam would on one hand protect local people from detrimental flash floods, and on the other hand stop regular beneficial flooding. As a consequence, it would heavily affect recession agriculture, making them more vulnerable to drought and increasingly food insecure. Their traditional coping capacities would be insufficient; mitigation measures are thus necessary for their survival.

Regional Stability

The impoundment and operation of the dam will displace Lake Turkana shoreline southwards, by about 10 km (on the basis of a lake drop of 1.7 m for a land slope of 0.17m per km. The northern shoreline of the lake will come close to the boundary between Ethiopia and Kenya. The stabilization of the Lake level over the year and the cancellation of the natural Omo floods will also reduce the pastureland in the delta. As a consequence, it may force the Dasenech to move further into Kenyan territory and Llemi triangle area during the dry season. If the Llemi dispute is not settled (and it is probable considering the rising tension between South and North Sudan exacerbated by the discovery of oil reserves), it could increase the likelihood of violent conflicts between ethnic groups.

It is therefore crucial, before, during and after the dam construction, to pay attention to these transboundary problems in order to avoid them. If carefully planned, the dam could serve as a reason to gather all concerned stakeholders on both sides of the border in order to find solutions to these regional security problems.

Without mitigation and compensation measures, the dam may increase some of the causes of conflicts identified in the baseline situation analysis, and reduce others, as detailed in the Table [28] below.

Particular care and attention must be paid to avoid the realization of causes a), d) and e), leading to impoverishment and conflicts. For that purpose, the main measures to be taken are not specific to conflict but are the same as those for livelihood restoration, mitigation, compensation and the reaching of free prior informed consent of the indigenous populations, around a regional development strategy and benefits sharing of the dam.

Additionally, it is recommended that all measures and subprojects implemented would be conflict-sensitive[64], involving distinct ethnic groups and capitalizing on the cooperation mechanisms developed by the people themselves (e.g. women, some sub-tribes specialized in peacebuilding, and the like.) or local NGOs (e.g. EPaRDA). Inter-ethnic agreements on free movement, inter-marriage, economic diversification, trade and the like were identified locally as potential mechanisms.

[64] Strecker, Ivo (1987), Hamar Relief Proposals

Table [28] - Project impacts on cause of conflicts, without mitigation & compensation measures

Increasing pressure on causes of conflicts	Decreasing pressure on causes of conflicts	No specific pressure on causes of conflicts
a) Conflict over scarce or limited natural resources: reduction of recession agriculture and additional pressure on pasture land may exert a strong pressure inducing conflicts	b) Cultural traditions of glorification of warriors and of killing may decrease as tourism, interest towards the region and developments potentially induced by the dam would raise	c) Historical relationships between groups, such as long-lasting conflicts leading to animosity and revenge: no direct impact of the Project
d) Cross-border issues: decreasing size of Lake Turkana and subsequent displacement towards Kenya may force Dasenech pastoralists to enter deeper into Kenya		f) Large supply of modern weapons: no direct impact of the Project
e) Dispossession and marginalization: without proper consultations, mitigation and compensation measures, there is a risk of the dam increasing the marginalization of the affected populations and dispossessing them of more lands (recession and pasture lands).		g) Dowry payment needs: no direct impact of the Project

Permanent conflict monitoring during the construction and operation phase is strongly recommended. As stated previously, appropriate method and concrete measures are yet to be proposed.

Finally, a Grievance Redress Committee downstream with representatives of the affected populations and local authorities in order to resolve disputes and conflicts associated with the implementation of the project and resettlement should be established.

8.4 Consultation Process

Objectives

The RAP lists the main objectives of consultations as:

- To inform PAPs about and discuss the nature and scale of adverse impacts of the project on their livelihoods in a more transparent and direct manner and seek their participation in the project cycle.
- To give PAPs and other members of affected communities a chance to have a say and express their views in the planning and implementation of the Gibe III project that affect them directly.
- To obtain qualitative as well as quantitative information on viable income generation and livelihood interventions which PAPs could engage themselves in order to restore their income and livelihoods in a self-sustaining manner.
- To inform local authorities of the impacts, agree on a cut-off date, solicit their views on the project and discuss their share of the responsibility for the smooth functioning of the overall project operations.
- In the case of second round consultations, the main objective was to ascertain that re-routing of the realignment path through dense settlements is the interest of not only other members of the affected communities but is also that of PAPs who will be affected by the project more directly and disproportionately.

Whereas the first two points are central objectives of consultations, it is not a goal of consultations as such to obtain survey related information from the PAPs (third bullet). It might be this partial objective that has led the ESIA consultants to carry out consultations in representatively selected kebeles for the downstream area.

Establishment of a cut-off date is crucial for project planning and effective implementation. However, the date should not only be informed to the local authorities but just as well to the PAPs. The RAP fails to document the announcement of a cut-off date. In order to avoid claims from people settled in the project impact area after this date and to protect those people who are rightly entitled to compensation from the project, it is crucial that the cut-off date is publicly announced. It should be added that the consultation process has documented that (some of the) PAPs are aware of the implications of a cut-off date.

A cut-off date for PAP eligibility in the downstream area should be established to avoid mass influx of people from areas outside the impact zone. This should be announced in conjunction with execution of a census of all project affected households.

A proper consultation procedure will allow a first consultation for the issues listed in the first two points above, including presenting the project's policy towards mitigation, compensation and eligibility. The comments and suggestions from the various stakeholders will be taken into consideration by project planners and used in the preparation of the ESIA documents. A second round of consultation will thereafter present the detailed planning in these documents after which comments will be included into a final version of the documents. This two-stage process has not taken place and where two rounds of consultations have taken place, it has been for other purposes, i.e. discussion of re-routing of the Chida-Sodo Road.

Coverage

Consultations are meant to cover all stakeholders. These include project affected people, government officers from various live agencies at federal, regional, zone, woreda and kebele levels, national park authorities, NGOs working in the project area as well as NGOs with specific interest in the project issues.

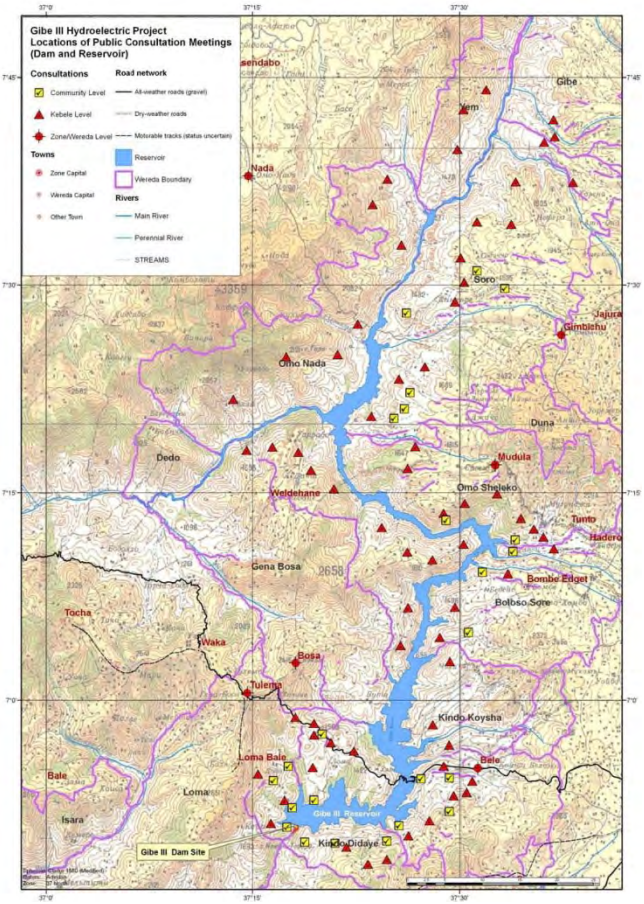
In communities throughout Ethiopia the man is representing the household towards the outside world. It has therefore appeared naturally for them – and for the women – to have the men take part in meetings about the Gibe III Project. However, many project impacts will affect women at least as hard as they affect men, so not only from a gender balance point of view but also to let the Project benefit from the suggestions from female participants it is essential to include this group as well.

Presentations from the consultation teams have been carried through translation from Amharic to local languages – Woleyta and Dawro along the Chida-Sodo Road, and Mursi, Karo / Hamer, Nyangatom and Dasenech in the downstream area. However, PAPs have in general not been able to read any written material (in Amharic) that might have been produced. The project has therefore recently started to translate an executive summary of relevant ESIA documents into local languages.

In addition, efforts should be made to ensure that project impacts are understood. Most of the people interviewed by the ESIR Consultant explained in more or less same words that the water in the Omo River will be diverted (which probably comes from explanation about the temporary diversion tunnels) and that the current low water level was caused by the dam blocking the river (even though construction of the dam has not yet started). This indicates that the consultation team has not managed to properly explain about the project, despite the use of relevant photographs. Improved illustrative presentations and a study tour to the construction site for village representatives would enhance understanding of the project and for the current situation that the low water level has natural causes.

Consultations in the Reservoir / Chida-Sodo Road / Employers Permanent Camp areas have covered all affected kebeles but not all affected communities (see figure below); in particular communities on the right bank of the future reservoir seem to have been left out. Similarly, for the villages affected by the Transmission Line a sample of The RAP has included women and vulnerable groups in the consultations but it is not documented in the records from the consultation.

Figure [30] - Location of public consultations held at community, kebele and woreda levels (upstream area)

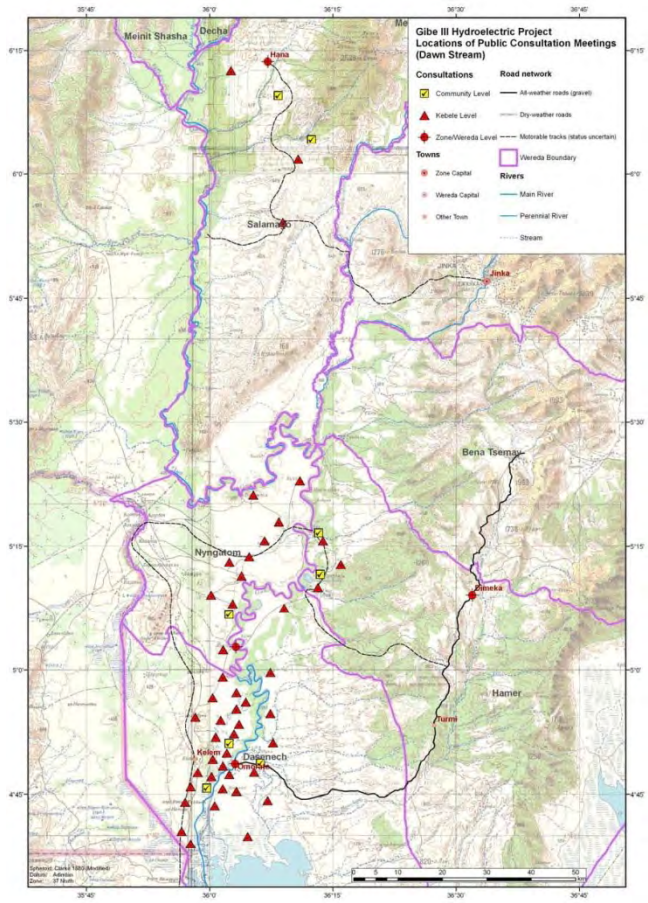


Consultations in the downstream communities are also based on a representative sample covering communities in only seven out of 63 potentially affected kebeles. Consultation with kebele representatives covered most of these kebeles (see Figure [31] below, Source: Gibe III PCDP).

In future consultations it must be ensured that

- All potentially affected communities are included.
- Both men and women take part, if necessary in separate groups.
- Presentations are made in a way that is easy to understand, reflecting local language and literacy level and using simple illustrations.
- Feedback from ideas raised at previous consultations is provided with clear distinction between which suggestions are within the responsibilities of the project, which ideas will be positively considered, and which are beyond the responsibilities of the project.

Figure [31] - Location of public consultations held in the downstream area



Disclosure

Current ESIA documents have been made publicly accessible on the Gibe III Project website[65], although the latest version of the RAP from December 2009 has not yet been posted. Project summaries in respective languages are being made available at woreda and kebele offices. This process is commendable and should be continued whenever new documents or events make it relevant.

It should be considered to hold a more comprehensive workshop for the general public, including NGOs, academics and representatives from Civil Society Organizations. This should take place once all relevant studies and plans have been concluded but in time for relevant comments to be included in the detailed planning of project implementation.

It is further recommended that the public is being kept informed about progress of the project including issues arising through the website (one-way communication) and by arranging regular stakeholder workshops (two-way communication).

8.5 Summary and Review of ESIA Proposed Social Mitigation and Monitoring Measures

Resettlement and Livelihood Improvement

Resettlement versus Compensation Approach

International resettlement practice prescribes that houses, residential land and farm land affected to a degree where it cannot fulfil its intended purpose be replaced by structures and land to at least the same size and standard while meeting certain locally accepted minimum standards. Only in exceptional cases based on prevailing conditions should cash compensation be accepted. This is due to the potential risk of financial mismanagement by the affected household or its individual members.

Land Availability

The RAP consultant has in collaboration with local authorities and through consultations with PAPs investigated whether additional farm land in the area was available and concluded that it is not possible to find sufficient replacement land in the nearby vicinity, individually for each affected household or as a group. The ESIR Consultant observed the high population density and pressure on land. However, for households keen on receiving land-for-land compensation, it could be investigated whether suitable land would be available further away – however, ideally within same ethnic area, i.e. Woleyta and Dawro, respectively.

Livelihood Options

A two-pronged approach is presented in the plan:

1. Land–Agriculture based strategies, mainly for households who have sufficient land to implement the proposed activities. This approach is split into two sectors:

- Crop production, with the following elements: (i) Intensification, (ii) Crop diversification, (iii) Natural Resource Management, and (iv) Commercialization.
- Livestock production, with the following packages: (i) Livestock fattening, (ii) Milk production, (iii) Poultry, and (iv) Beehives.

The RAP notes that households that lose most of their land could still opt for livestock activities as part of their livelihood restoration / improvement measures.

65 http://www.gibe3.com.et

2. Non-farm income restoration strategies, mainly for households facing a severe loss of farmland and remain with an unviable land holding, assessed to be 165 households. This will include PAPs with previous experience with non-farm activities and PAPs with total and severe loss of farmland. The types of activities foreseen include: (i) Small-scale trade, (ii) Small businesses and services, (iii) Artisan and handicrafts, (iv) Commercial fishery in the future Gibe III Reservoir, and (v) Project related employment, e.g. temporary jobs in construction activities related to the dam, road, etc.; and permanent employment at the Employers Permanent Camp.

Whereas the livelihood activities appear to be relevant and appropriate the RAP gives no indication of the scale of support to each affected households apart from a budget line for each activity, totalling 3,000 – 8,000 E.Birr per household. An activity plan with suggested activities, input, staffing and unit cost would enable an assessment of whether the proposed budget is sufficient. Besides, whereas the text (and the table below) suggests a combination of livelihood activities for each household depending on severity of impact, feasibility and PAP preference, the budget table anticipates one activity per affected household.

Table [29] - Number of affected Households and Livelihood Support Packages.

Description of Impact (Land Lost as % of Existing)	Income Restoration / Improvement Packages	Number of PAPs	Percent
20 % and Less	Full Crop Production Package	474	53
21% to 50%	Full Crop Production Package and a Half Livestock package	168	19
51% to 100%	Full Livestock Package, full Crop Production (as appropriate) and Non-farm Strategies	165	18
Lost no Land	No Assistance Needed	85	10
Total		892	100

Source: RAP, Table 9.1.

Before embarking on support for various non-farm based activities, it would be useful to make an assessment of the demand for the various products and services to be offered from these in the area. This knowledge will be valuable for each household to avoid an over-supply of specific goods.

Vulnerable Groups

Vulnerable households along the Chida-Sodo Road realignment and Employers Permanent Camp will be entitled to specific assistance in addition to what the normal PAP will have according to the impact. The types of special assistance measures for vulnerable groups include:

- Food security assistance
- Health assistance
- Education assistance (for children) and
- Additional relocation assistance (e.g. assistance for construction of houses for those vulnerable PAPs whose houses will be affected).

There is an estimated 114 vulnerable households, identified as female headed (47), headed by an elderly person (42), having members with disabilities (17) and headed by a child (8). In addition, the RAP recognizes that households losing their house and more than half of their farm land should be seen as vulnerable. Whereas the former group is vulnerable independently of the Project, the latter is seen as vulnerable because of Project impacts. Hence, the attention and assistance needed for these two groups might not be similar.

It can be assumed that some vulnerable households will also need special assistance to pursue new or improve their current livelihood activities. Hence, careful attention will be given to poor and vulnerable households and severely affected households as also indicated in the RAP.

The ESIA-DS has not properly identified vulnerable groups in the downstream area apart from a vague definition. Special attention should be given to the identification of these in the socio-economic surveys to be carried out as well as in the design of compensation measures. Measures could include temporary food assistance and extra support to establish / improve livelihood activities.

Resettlement Budget

The RAP of January 2009 proposed a budget for compensation measures due to relocation of 23,656,164 ETB, or 2,215,764 US$. This figure was used both in the RAP, ESIA and EFTA reports. The number of directly affected persons amounted to 2,627 persons in 355 households. However, following changes in the projected road location due to the wishes of the surrounding communities (i.e., the road to be closer from the densely populated areas), the number of affected people would increase to 6,223 in 892 households – of which 135 will lose their residential house (in total 141 houses). The report was updated in December 2009, and new lists of beneficiaries were established.

The cost for cash compensation for the dam / reservoir is nearly the same, but significant changes were made in the budget for Chida-Sodo Road realignment (from about 7.4 to 30.4 million Birr and for the Employers Permanent Camp, decreasing from about 9.7 to about 4 million Birr. In turn, the social development plan (also including livelihood income improvement measures) raised from about 76.5 to 88.9 million Birr. Consequently, the total budget was raised from 117.5 to 151.5 million Birr, mainly due to the increase of the number of people to be resettled.

Annex 7 of the updated RAP report gives tables of the number of people to be resettled for each kebele. Aggregated data is presented in the table below.

Table [30] - Compensation to be paid to Households affected by road, camp and reservoir (Birr).

	Project Component	Woreda	Kebele	Number of bene-ficiaries	Farm land	Houses and other Estab-lishments	Perennial crops	Total Compen-sation	Average cost per person
1	Road	Kindo Didaye	Patata	142	1,132 549	1,496,440	1,103,683	3,732,672	26,286
2	Road	Kindo Didaye	Zaro	147	37,785	81,700	6,558	126,043	857
3	Road	Kindo Didaye	Gocho	69	369,050	2,263,020	273,330	2,905,400	42,107
4	Road	Kindo Didaye	Mogisa	73	568,296	753,800	625,879	1,947,975	26,684
5	Road	Kindo Didaye	Waruma	3	28,435			28,435	9,478
6	Road	Kindo Koysha	Manara	98	1,431,027	1,235,300	588,708	3,255,035	33,214
7	Road	Kindo Koysha	Molticho	6	174,100	5,000	7,664	186,764	31,127
8	Road	Kindo Koysha	Fujenamata	10	177,113		3,850	180,963	18,096
9	Road	Kindo Koysha	Cherecha	71	894,280	1,585,588	601,864	3,081,732	43,404
10	Road	Kindo Koysha	Hanaze	29	790,530	10,000	147,538	948,068	32,692
11	Road	Loma	Adisu Bodere	40	1,500,805	126,700	1,085,129	2,712,634	67,815
12	Road	Loma	Afaki Sori	27	1,481,090	566,900	91,501	2,139,491	79,240
13	Road	Loma	Dodi Angela	19	591,964	410,000	125,756	1,127,720	59,353
14	Road	Loma	Gumari Kocho	13	428,985	205,000	72,246	706,231	54,325
15	Road	Loma	Lala Anebe	13	286,808		97,064	383,872	29,528
16	Road	Loma	Suba Tulema	22	709,073	5,000	42,705	756,778	34,399
17	EEPCO Camp	Kindo Didaye	Zaro	51	1,550,400	1,443,854	982,896	3,977,150	77,983
18	Dam and reservoir	Kindo Didaye	Gocho	50	2,728,320		1,197,367	3,925,687	78,513
19	Dam and reservoir	Kindo Didaye	Zaro	1	15,750		15,555	31,305	31,305
20	Dam and reservoir	Loma	Yelo Werebate	1	226,500		15,006	241,506	241,506
21	Dam and reservoir	Loma	Zima Waruma	6	2,268,750			2,268,750	378,125
	TOTAL			891	17,391,610	10,188,302	7,084,299	34,664,211	66,478

These figures differ from those presented in the summary estimated budget (Table 0.2 p 12 of the updated RAP). According to the latter, the entire budget for resettlement, including a social development plan, evaluation and monitoring, would amount to 24,349 ETB per person, i.e. 6.3 times the estimated annual cash income in the area[66], or 5.7 times the average 2010 Ethiopian GDP/capita[67]. It is clearly within the recommendations of the World Bank Involuntary Resettlement Sourcebook of 3 to 5 times GDP/capita. The budget for the social development plan is quite generous, amounting to more than the double of the compensation budget.

However, given the inaccuracies observed, it is recommended to carefully revise the resettlement action plan budget.

Resettlement Schedule

The RAP indicates to spend a total of six months from the establishment of the RIU to the completion of compensation payment and moving compensated people[68].

Registration of assets and crops as well as compensation amounts is completed. Actual payment of compensation to the 892 affected households should be feasible within the six months. However, relocation of the houses (typically within the land of the PAP) could well take longer time, as timing might conflict with the agriculture cycle in terms of labour demands. For households having to relocate away from their current landholding, resettlement land has to be identified and agreed upon (as indicated in the RAP schedule). This could well take more than six months, depending on the number of PAPs having to find new resettlement land – such a figure is not given in the RAP.

Should the process be delayed by more than a year from the time of agreeing on compensation amounts with the PAPs, these amounts might have to be adjusted for inflation (currently around 7% p.a.)

Additional mitigation Measures

The current realignment of the Chida-Sodo Road has led to a larger number of households being affected compared with the original alignment closer to the future reservoir. To minimize the impact in the populated areas and to reduce the compensation cost, the ROW of the road has been reduced from 30 to 20 m.

66 3,848 ETB as stated in RAP December 2009

67 About 400 US$; source: IMF

68 RAP, p. 165.

The ROW has been demarcated in the field and impacts for each household are documented in the annexes of the revised RAP. The grievance procedure and the monitoring mechanism will detect whether the road construction machinery manage to keep within this narrower corridor.

Whereas the Employers Permanent Camp initially would affect the houses of 28 households this has been reduced to 18 households after the location was shifted a few hundred meters. Farm land affected is likewise reduced from 14 to six hectares.

Downstream Social Mitigation Measures

Irrigated Agriculture

The ESIA-DS proposes three types of potential interventions in irrigated agriculture in order to provide alternatives sources of survival for the populations practicing flood recession agriculture:

- Implementation of small irrigation schemes (100 irrigated schemes of 20 ha (2,000 ha), settled by 80 families with 0.25 ha each.
- Small-scale commercial irrigated farms (100 farms of 3 ha each).
- Large scale irrigations farms over 7,200 ha (for cotton and sugarcane plantations).

The households affected by the construction of the dam and dependent on post-flood recession crops will not take advantage of the development of large commercial farms which will need heavy private investments in terms of infrastructure (factories, roads, etc…). The top priority must be given to the development of small-scale irrigation schemes. In the few existing schemes farmers have gradually become more interested in irrigated agriculture and have required the extension of the cropped area.

Small scale irrigation schemes

Implementation of small scale irrigation schemes (20-50 ha) will be important to help compensate adverse effect on livelihoods giving people more food, increased cash income and better nutrition. The main project intervention to achieve this goal will be the capability of assisting farmers to deal with the main constraints they are facing. Local level involvement will require strengthening of woreda and kebele level branches of MARD and MWR in site selection, funding and the design and organization of system maintenance; the first step in the process is to collect preliminary data together with the rural communities in selected project areas. This requires the involvement of the community at the identification and planning stages with guidance provided by zonal level technical staff.

Identification of potentially irrigable areas has to be achieved on the basis of the existing land suitability classification and will require more information on soil salinity and alkalinity in order to avoid posterior issues and insure the best location. A preliminary map with a dozen of potential areas was prepared to help with this objective. The site selection must adhere to a number of criteria including technical, social, land tenure, infrastructure, output disposal, environmental and organizational aspects. The social soundness criteria require that there is a firm commitment by the community to contribute for the construction and to undertake the operation and maintenance of the scheme.

Cropping patterns predominant in the existing schemes could be adopted in the new proposed sites as the farm size of 0.25 ha. Double cropping of maize and sorghum are envisaged in the ESIA-DS, but such cropping intensity is very optimistic. The productions and water requirements calculations proposed in Table [31] below, are based on two more conservative cropping intensities (i) of 100% involving 70 % of grain crops, (30% sorghum including ratooning , 40% maize), 25 % of vegetables (tomatoes, onions and beans) and 5 % of fruit trees (bananas) and (ii) of 150 % involving 120 % of grain crops, (30% sorghum including ratooning, 90% maize), 25 % of vegetables (tomatoes, onions and beans) and 5 % of fruit trees (bananas).

Maize should be capable of yielding 25 Qt/ha. Sorghum can be expected to yield 30 Qt/ha from the two harvests. Grain production from each farm ha would amount 475 to 780 kg depending of the cropping intensity: single or double maize crop. The amount of grain produced per family will exceed the amount that a family of 5 persons would require for their own consumption. Grain crops are usually too low in value to pay for pumped irrigation but as markets for high value crops like vegetables and bananas develop the proportion of these might be expected to increase.

The irrigation water requirements for a 20 ha scheme will be between 256,000 m^3 (cropping intensity of 100%) and 360,000 m^3 per year. For 100 small scale irrigation schemes, i.e. 2,000 ha, the irrigation water requirements will therefore be between 26 and 35 hm^3.

Small Scale Commercial irrigated farms

The ESIA-DS anticipated that some individuals would wish to have larger farms, in effect a small-scale commercial unit. It is assumed, for this purpose of that 100 such farmers would take advantage of the regulated water supply and that each farm will have 3 ha of land, on average.

They would mainly grow bananas and vegetables as high value cash crops, but also some food crops.

A possible cropping pattern might be: 1.75 ha bananas, 1.0 ha maize (with double cropping) and 0.25 ha vegetables. The proportion of vegetables in particular, will depend on market demand.

Table [31] - Projected productions from a small irrigated farm (0,25 ha)

Extensive cropping pattern: Soghum/maize/beans/vegetables/ bananas Farm Size: 0.25 ha	%	Area (ha)	Yield (qt/ha)	Production (kg)	Water requirements (m^3)
Sorghum (2h)	30%	0.075	30	225	1,075
Maize	40%	0.1	25	250	1,048
Beans	15%	0.0375	15	56	404
Vegetables	5%	0.0125	100	125	117
Tomato	5%	0.0125	100	125	145
Bananas	5%	0.0125	100	125	411
Total	100%	0.25			3,200

Extensive cropping pattern Soghum/maize/beans/vegetables/ bananas Farm Size: 0.25 ha	%	Area (ha)	Yield (qt/ha)	Production (kg)	Water requirements (m^3)
Sorghum (2h)	30%	0.075	30	225	1,075
Maize	45%	0.1125	25	281	1,179
Maize	45%	0.1125	25	281	1,085
Beans	15%	0.0375	15	56	404
Vegetables	5%	0.0125	100	125	235
Tomato	5%	0.0125	100	125	145
Bananas	5%	0.0125	100	125	411
Total	150%	0.375			4,533

Table [32] - Productions and water requirements on a 3 ha commercial farm

Crop	Area (ha)	Yield	Production	Water requirements	
	ha	Qt/ha	Quintals	m3/ha	m3/farm
Maize	1	50	50	14,084	14,084
Bananas	1.75	200	350	23,031	40,303
Vegetables	0.25	200	50	6,579	1,645
Total	3				56,032

Production from each 3ha farm would amount to 5 tonnes maize and 35 tonnes bananas (see Table [32] above). Total production from 100 of such small commercial farms will therefore amount to 500 tonnes maize, 3,500 tonnes bananas and 500 tonnes of vegetables. Irrigation water requirements for 100 small commercial farms will therefore amount about 6 hm3.

The main interventions in irrigated agriculture should include the creation of irrigation settlement schemes for smallholders, initially managed by the authorities and eventually by farmer associations and financial assistance to individual small-scale commercial farmers.

The main developments for irrigated agriculture might be as follows:

- Creation of irrigated settlement schemes for smallholders,
- Supporting development of individual small-scale irrigated commercial farms,
- Capacity building of extension services so that they are equipped to assist farmers in the successful development of irrigated agriculture.

The irrigation mitigation interventions will be studied for small-scale subsistence and commercial farms in detail by a technical assistance team based in Omorate. Total costs for surveys; projects preparation, supervision, capacity building and training was estimated to amount to 3.5 million Birr (190,000 Euros). The total cost will be 32.0 million Birr (1.72 million Euros) for a 4 years construction phase. Total costs (without contingencies and administration costs) are estimated at 40,000,000 Birr.

The annual production from irrigated cropping, after full implementation of the proposed interventions, is estimated at 1,800 tonnes of sorghum, 2,500 or 5,000 tonnes of maize depending of the cropping intensity, 4,500 tonnes of bananas and 2,500 tonnes of vegetables, as shown in the following table. The total irrigation water requirements will therefore be between 31 and 41 hm^3.

Table [33] - Productions and irrigation water requirements after interventions for small farmers

	Cropped area		Production		Water requirements	
Cropping intensity	**100 %**	**150 %**	**100 %**	**150 %**	**100 %**	**150 %**
	ha		**Tonnes**		**hm3**	
Sorghum	600	600	1,800	1,800	8.6	8.6
Maize	900	1,900	2,500	5,000	9.8	19.5
Beans	300	300	450	450	3.2	3.2
Vegetables	225	225	2,500	2,500	2.3	2.3
Bananas	275	275	4,500	4,500	7.3	7.3
Total	2300	3,300			31.2	40.9

Fisheries

In order to extend the water availability in the delta during dry season, and at first in the oxbow lakes, it will be possible to store water, thanks to simple concrete works (sluice gates) allowing to determine the water level for drawdown agriculture and irrigation. Such a decision should be taken after interviews with the concerned populations.

The storage of water will allow development of extensive fish culture from existing species, which find good conditions in stagnant waters (*Clarias gariepinus, and Tilapia sp.)*

Monitoring

Monitoring of resettlement and livelihood improvement along the Chida-Sodo Road realignment and at the Employers Permanent Camp will have three components, as presented in the table below. Continuous monitoring will be handled by the RIU and resettlement Field Officers (RFOs).

Table [34] - RAP Monitoring, Review and Evaluation Framework.

Component	Type of Data Information	Source of Data	Main Responsible Body	Frequency / Number
Monitoring (IPM)	Measurement of Input-output data and indicators. Financial and physical performance data	Internal records Field observations Monthly monitoring / progress reports Survey and questionnaires Meeting with project staff	RIU, RFOs	Continuous
Progress Review	Measurement of input-output data. Assessment of satisfaction of PAPs with RAP activities and inputs. Assessment of major problems and challenges	Consolidated IPM reports. Sample surveys and qualitative / participatory	RIU, RSC	Monthly
External Evaluation	Measurement input-output indicators Assessment of impact of project on PAPs Assessment of achievement of RAP objectives in terms of improving the income and wellbeing of PAPs and communities	Secondary-documentary sources. Primary data through sample survey and qualitative-participatory methods Focus group meetings	RIU. External agency / consultant	1 (terminal / completions)

Source: RAP, p. 161.

It is also noted that the EMU is not yet part of the internal monitoring, as is currently their mandate.

Monitoring of livelihood restoration and improvement in the downstream area has been outlined in a monitoring plan that also includes environmental issues. The four groups of social and economic parameters to be monitored are agriculture, livestock, household performance and ethnic conflicts. These parameters are all relevant but no reference is given to the method apart from a "survey".

Such a survey should build on the baseline survey suggested above. Livelihood development cannot be monitored through income and quantity of market sales only as the households in this area are predominantly subsistence oriented. Agriculture, livestock and other products consumed within the household will have to be quantified and valued as they constitute the main part of the livelihoods for the PAPs. Other indicators for livelihood improvement could include food consumption (quantity and quality), nutritional deficiencies and health.

Table [35] - Monitoring Plan, Social and Economic Indicators, Downstream Area

Parameters to be monitored	Monitoring Purpose	Monitoring Location	Monitoring Method	Frequency (5 years period)
Agriculture: riverbank and floodplains extension and productions; input supply, sale prices	Trends	Strip 20 km wide along river and delta area	Land cover updating, Woreda records	Yearly
Livestock: consistency, localization, migration, feed sources and health conditions	Baseline and trends	4 Woredas	Survey by Livestock Expert, Woreda records	Yearly
Changes in food consumptions, incomes, health status, quantity of market sales, water uses for agriculture	Trends	Strip 20 km wide along river and delta area	Survey by Socio-economic Expert, Woreda records	Yearly
Tribal issues and sources of conflict	Trends	4 Woredas	Survey by Anthropologist	Yearly

Source: ESIA-DS, p. 200.

Chapter 9. Conclusions & recommendations

9.1 Environmental Issues

In the Construction & Reservoir zones

Construction sites: Within the construction areas, the environmental and social obligations and good practices are considered appropriately managed by the EPC Contractor's staff. Mitigations proposed in the ESIA are efficiently implemented on the sites. No additional measure is required under the present conditions.

Reservoir buffer zone: The ESIA proposes the implementation of a buffer area around the reservoir. The purpose of this measure is not clear to the ESIR Consultant and looks questionable considering (i) the significant budget dedicated to the measure, (ii) the low population around the area , (iii) the need for the pastoralists to access to the drawdown zone to replace for the loss of the grazing area flooded by the reservoir, (iv) the public access to be provided (in nine points) for the crossing of the reservoir and also for the future fishermen, (v) the probably limited wildlife which presently takes refuge in the narrow riverine forest. The ESIR Consultant recommends that the decision for the buffer zone creation is made after further wildlife investigations and a reservoir development plan are completed.

Wildlife: Additional wildlife investigations are also required in the Mago and Omo National Parks in order to better understand the relationship of the wildlife with the Omo river, in particular drinking points and crossing points (if any). Close coordination with the Park authorities is recommended as well as their involvement in the assessment of wildlife management prior and during first reservoir filling.

Reservoir Forest Clearance: With more than 200 km² of reservoir area, only a small part can be reasonably considered for clearance. The riverine forest may be first targeted for natural resource collection (presence of wildlife, of valuable wood?), but if the interest is limited, a simple burning (to remove the soft biomass which decays rapidly) without hardwood removal may also be considered. Clearance strategy, still to be defined, must be considered in conjunction with (i) wildlife management issues, (ii) fisheries development plan proposed and (iii) the future management of the drawdown zone. Some other areas of the reservoir should require clearing as part of the drawdown area for access to boats and for fishing. Additional studies on reservoir riverine forest and wildlife are recommended and already committed by EEPCo.

Watershed Management: Measures related to watershed management are also questionable, and mixed with discharge control issues in the ESIA. The proposed budget is significant (562,000 US$) while limited information is provided on the intended measures. For the ESIR Consultant, due to the geographical extent of the issue and its complexity in a densely populated and cultivated watershed, erosion control should not be considered as a mitigation priority at Project level as sediment is not a direct threat to reservoir operation and life.

Reservoir Area: It is recommended to integrate all the issues related to the reservoir area (reservoir operation, wildlife management, agriculture and livestock development, fisheries development) into a comprehensive Reservoir E&S Development Plan.

In the Downstream Area

The ESIA process conducted so far has established a consensus on the nature of downstream effects caused by the Gibe III operations: the regulated river flow will (i) reduce the flood recession agriculture activities carried out along the Omo river banks and in the oxbow lakes, and (ii) cancel the seasonal flooding of the delta area with severe impacts on recession agriculture, grazing lands, wetlands and biodiversity including fish spawning areas.

To what extent these components would be affected is an information still dramatically missing (i) to finalise the project impact assessment, and (ii) to propose appropriately designed mitigation/compensation measures. There is a need to clearly identify and quantify the population, economic activities and natural habitats likely to be impacted by the altered river flow, hence to identify and define the most cost-effective mitigation measures. This is particularly needed in the Omo delta area which concentrates most of the biodiversity issues and socio-economic activities, both being totally dependent upon the water regime. From then, a strategy to effectively mitigate and compensate the potential affected component could be developed.

There is almost no detail on the measures to be implemented in the downstream Omo area, as the development packages proposed do not provide description of content. No technical studies are defined to support the development of the packages for irrigation. The budget anticipated in the downstream zone is very significant as it amounts about 18 millions US$ and the way it has been established and it should be used needs to be clarified.

The mitigation strategy proposed by the ESIA is based on the creation of seasonal artificial floods by a temporary additional water discharge through the Gibe III dam middle outlets, in order to maintain the traditional recession agriculture activities mainly along the Omo river banks. However, several flaws may be identified in this approach: (i) Except the flood gauge at Gibe3 site, there is no effective measurement of the Omo river flow along its 750 km between Gibe 3 and Lake Turkana, thus the flow contribution of this intermediary catchment is only assumed, not verified; (ii) the artificial flood is anticipated to last 10 days, but the hydraulic behaviour of this event along the 750 km of river has not been studied meaning that its actual impact downstream is still uncertain, particularly regarding the flooding of the delta; (iii) a rapid assessment of the artificial flood cost in terms of lost production of energy leads to the conclusion that probable conflict of interest may quickly erupt in the future, particularly because of dry years or when the energy demand increases; (iv) the solution proposed is limited to only the preservation of the present recession agriculture, instead building a more ambitious social and economic development of the lower Omo based on new opportunities offered by Gibe III.

Alternative mitigation options should be considered which (i) ensure the long term preservation of the delta and (ii) optimize the social and economic benefits to be expected from the new hydrological conditions.

9.2 Social Aspects

Modalities of Cash Compensation

Great care should be taken that households eligible to compensation for loss of residential houses and other structures and land, spend the compensation money in a way that will restore and improve their livelihood compared to the pre-impact situation. Hence, the following measures are recommended:

- Each household eligible for cash compensation should with the assistance of the Kebele Resettlement Committee make a plan for how to spend the funds. Guidance should be given to ensure that housing is re-established and sustainable livelihood activities are being developed.
- Cash payments should be paid only with both male and female heads of households present (where applicable) and countersigned with signatures from both heads.
- Cash compensation should be paid in instalments, whenever the amount exceeds a certain level identified as suitable by the Woreda Resettlement Committee, based on what the funds are intended to compensate.
- Awareness or training in financial management should be provided to all heads of household eligible for cash compensation.
- Monitoring will document whether PAPs are spending the compensation funds in a financially and socio-economic sound manner. Corrective measures will be taken.

Introduction of a Target for Livelihood Improvement

Livelihood support to households losing their farmland has been given no specific target in the RAP. The aim is to restore and even improve the livelihoods of these PAPs. Livelihood can be interpreted and thereby monitored through use of various definitions and components. These could include a combination of:

- Livelihood income (cash and kind);
- Consumption (pattern and quantity); and
- Health and nutrition.

To ensure proper implementation of any livelihood improvement programme it is crucial to have:

- A baseline with data reflecting the livelihood programme support parameters.
- A target linked to current situation with an aim to improve. Such a target will enable the project directing the support and to know when to phase out the programme.

With the current approach, the project might face criticism for not providing sufficient support and will not know whether this is true or not. However, with a target the project will work towards an agreed goal. Likewise, there should be a success criteria defined by e.g. 80 or 90% of affected households reaching the agreed target as it cannot be expected that all households will be able to reach a given target.. Remaining households will get additional support but the project cannot sustain their livelihoods in eternity.

Downstream Area Mitigation and Compensation

The main mitigation measure proposed in the downstream area is the controlled flood, which will enable recession agriculture and pasture lands to be utilized in the future. However, the ESIR Consultant is not yet convinced whether this measure will cover the area and time needed in order to simulate to pre-impact situation. The suggested barrage across the Omo River will enable irrigation of large areas – including some pasture lands – in addition to maintaining / developing recession agriculture.

Hence, the main farm-based compensation measure is the development of small-scale irrigation systems.

Other measures include support to fisheries and livestock development and a set of socio-economic development activities: agriculture training, coordination of food aid, conflict prevention and resolution training, and general capacity building among local level government staff.

All these measures are relevant but for proper planning they require feasibility studies and a land capability assessment as well as a quantification of the impact in each impact zone. This planning should go hand- in-hand with consultations with PAPs to identify which compensation options are preferred in each household.

Funding of Downstream Area Programme

As the documents have not provided convincing evidence that the controlled flood will mitigate all impacts, it is too early to claim that all additional measures should be funded by sources outside the project. Even though the proposed contributors are GoE and EEPCO – which obviously both have a vested interest in success of the project – it is in breach with general practice to externalize compensation payment in this way[69].

The Need for a Livelihood Development Plan

The impacts in the downstream area will not lead to resettlement of PAPs and there is therefore no need for a resettlement plan for this impact zone. However, a plan is nevertheless needed for the proper presentation of baseline data, impacts and plans to restore / improve the livelihood of PAPs.

If developed separately from the other ESIA documents, such a plan would typically include the following issues:

1. Project description

2. Legal and policy framework

3. Socio-economic baseline and ethnic, poverty and gender profiles

The baseline will provide valuable information about the PAPs and be a basis for monitoring. Each ethnic group will be represented in the baseline survey that will cover questionnaire interviews with village informants (leaders, school teacher, etc.) as well as household interviews with 10% of households and at least 15 households per kebele.

4. Scope of impacts

Apart from the impacts already identified in the ESIA-DS, this will also include the anticipated impacts from possible mitigation measures introduced, e.g. the controlled flooding recommended in the ESIA-DS or the barrage suggested in the current report. The impact assessment should be as detailed as possible and include the affected kebeles and number of households in each of these as well as loss of assets.

5. Entitlements

Entitlements will indicate (i) the categories of eligible people and/or communities and (ii) their entitlement to livelihood restoration / improvement according to the anticipated impact.

6. Consultations and disclosure

Consultations completed to date as well as those carried out in connection with this new document should be described including all names of stakeholders consulted, number of men and women participating, issues presented, raised and discussed and documents disclosed / means of disclosure.

Consultations will have to be carried out among all PAPs, not only selected representatives. Special emphasis should be given to ensure participation among women and vulnerable groups. Presentations will be language and literacy sensitive.

7. Livelihood development plan

The livelihood support activities recommended as compensation to the PAPs should be presented in detail with findings from a feasibility study on each of these and a land capability assessment. PAPs acceptance or preference of each of these options obtained through consultations should be taken into consideration.

Targets for project support should be established; these could include e.g. production outputs; livelihood income (cash and kind); and consumption and nutrition levels.

8. Ethnic minority development plan

A separate ethnic minority development plan or indigenous peoples plan[70] will not be necessary, as all PAPs in the project zone are ethnic minorities. However, special attention to cultural heritage, vulnerability, language, gender roles and institutional arrangements should be highlighted for each of the ethnic groups.

9. Monitoring

Internal monitoring will cover project effort as well as project outcome using indicators developed along agreed targets. External monitoring will be established along the principles established for the RAP.

10. Budget and schedule

A detailed budget for the livelihood development plan will indicate the annual level of support to each activity. A detailed budget could serve as a schedule as well.

9.3 Recommended Complementary Investigations and Measures Downstream

The recapitulative list of mitigation and monitoring measures proposed in the ESIA reports is provided in Appendix [13]. Overall, the ESIA has planned a solution without fully qualifying the problem and without studying its effectiveness which may be considered as the major weakness of the downstream mitigation plan.

[69] See e.g. World Bank OP 4.12, § 20.

[70] The term 'ethnic minority' is preferred in this report over 'indigenous' as several of the minority groups in question are not indigenous to the area. Whereas this would not change their status for the World Bank, the term 'indigenous' could cause misunderstanding among other readers of the document.

It is deemed necessary to reverse the intervention logic adopted so far. Until a clear understanding of the existing interrelations between the Omo river flow and the environmental and socio-economic conditions in the delta, it would be difficult (i) to propose the most effective solution for Omo river water management and (ii) to assess the cumulative effects resulting from the planned cascade of hydropower developments along the river.

This prerequisite implies two major fields of investigations which have not been carried out so far: (i) the hydrological and hydraulic assessment of the Omo river system, including particularly the lower Omo river reach to Omorate, the Omo delta and Lake Turkana, and (ii) the survey of the present socio-economic and ecological benefits from the Omo river in the plain and in the delta. When the results of these two fields of investigations are available, the Project will be able (i) to finalise the downstream impact analysis including cumulative impacts and impacts on Lake Turkana, (ii) to identify and analyze possible mitigation measures and development plans taking into account the specificities of the indigenous people living in the project-affected area, and (iii) to engage within an effective public consultation about the proposed measures.

The intervention logic of the proposed additional investigations is summarized below.

Hydrological & hydraulic assessment of the Omo System downstream Gibe III

Specific Objective

The hydrology and hydraulic behaviour of the Omo river system downstream Gibe III dam, including the Omo delta and Lake Turkana, are understood and characterized.

Result 1

The downstream hydrological impacts of the Gibe III hydropower project are quantified and localized.

Result 2

The relevance of the ESIA proposed artificial flood is assessed together with the conditions of its effectiveness.

Result 3

Alternatives to artificial flood, based on the best use of the Omo regulated flow, are identified as an opportunity to further biodiversity preservation and economical development such as irrigation, grazing, fisheries or rural electrification.

Socio-economic & ecological investigations in the Lower Omo

Specific Objective

The socio-economic and ecological services provided by the Omo river upstream Omorate and in the Omo delta are understood and characterized.

Result 1

The agriculture, grazing and fishery related areas dependent on the Omo river water fluctuations are mapped and described.

Result 2

Habitats and species of the project-affected area are mapped and characterized in terms of value and vulnerability to hydrological changes.

Result 3

The vulnerability of the indigenous agro-pastoral communities with respect to any changes in the Omo river regime is understood and characterized.

Consensual integration of findings

Specific Objective

A synthesis document is prepared in order to present to the general public the downstream project impact analysis and proposed mitigation plan, including enhancement measures.

Result 1

A draft mitigation and enhancement strategy is prepared prior to public consultation, covering all aspects of a regional development plan.

Result 2

The draft mitigation and enhancement strategy is presented to the project affected communities (Ethiopia and Kenya) and amended accordingly.

Result 3

A consensus on the Gibe III project impacts and mitigations is obtained, and the Plan implemented.

It is the conviction of the ESIR Consultant that the Gibe III Project, despite significant impacts, particularly in the Lower Omo area, could be an exceptional opportunity to foster the economic development of the delta region. A proactive attitude is necessary in order to maximize the new development opportunities induced by the Gibe III Project.

This approach should be preferred to the more passive attitude developed in the ESIA and limited to the restoration of an economic level situation well below the poverty level and confronted permanently to food insecurity.

Chapter 10. Appendices

Appendix [1] - List of documents made available to the ESIR team

	Category	Mandated by / Author				Title	Date	Pages
1	ESIA	EEPCO	CESI	Mid Day International		Gibe III - Environmental and Social Impact Assessment	janv-09	358
2	ESIA	EEPCO	Mid Day International			Gibe III - Environmental and Social Impact Assessment - Chida-Sodo Road Realignment	janv-09	133
3	ESIA	EEPCO				Gibe III – Sodo 400 kV Power Transmission Lines Project - Environmental and Social Impact Assessment	janv-09	98
4	ESIA	EEPCO	Agriconsulting S.p.A.	Mid Day International		Gibe III - Environmental and Social Impact Assessment - Additional Study on Downstream Impact - Level 1 Design	janv-09	297
5	ESIA	EEPCO	Agriconsulting S.p.A.	Mid Day International		Gibe III - Environmental and Social Impact Assessment - Additional Study on Downstream Impact - Maps	janv-09	20
6	ESIA	EEPCO	Salini Construttori S.p.A.	Mid Day International		Gibe III - Environmental and Social Management Plan	janv-09	238
7	ESIA	EEPCO	Mid Day International			Gibe III - Resettlement Action Plan - Dam and Reservoir Area - Vol 1 Main Report + Annexes 1 to 6	janv-09	238
8	ESIA	EEPCO	Mid Day International			Gibe III - Resettlement Action Plan - Dam and Reservoir Area - Vol 2 Annexes 7 to 12	janv-09	106
9	ESIA	EEPCO				Gibe III – Sodo 400 kV Power Transmission Lines Project - Resettlement Action Plan	janv-09	104
10	ESIA	EEPCO	Salini Construttori S.p.A.	Mid Day International		Gibe III - Public Consultation and Disclosure Plan - Level 1 Design	janv-09	226
11	Guidelines	European Investment Bank				Environmental and Social Practices Handbook	sept-07	133
12	Guidelines	European Investment Bank				The EIB Statement of Environmental and Social Principles and Standards (Attention: replaced by Febr 09 version)	2009	36
13	NGOs	Counter Balance				Challenging the European Investment Bank	20-nov-08	2
14	NGOs	Counter Balance				Letter	18-mars-08	1
15	NGOs	Umberto Guidoni (Parlement)				Interrogazione scritta E-3462/08 di Umberto Guidoni (GUE/NGL) alla commissione		1
16	NGOs	International Rivers				What Cost Ethiopia's Dam Boom? A look inside the Expansion of Ethiopia's Energy Sector	févr-08	26
17	NGOs	The University of Montana				Letter	18-mai-09	14
18	NGOs	The University of Montana				Letter	18-mai-09	15
19	NGOs	Campagna per la Riforma della Banca Mondiale	Les Amis de la Terre	International Rivers		Letter to JP Morgan Chase on the Gilgel Gibe III Dam		5
20	NGOs	Counter Balance	Campagna per la Riforma della Banca Mondiale	CEE bankwatch Network		The Gilgel Gibe Affair. An analysis of the Gilbel Gibe hydroelectric projects in Ethiopia. How states and corporations do business using international public money	2008	32
21	NGOs	Friends of Lake Turkana				Kenyan Request for Investigation of AfDB & Gibe 3 Dam	05-févr-09	3
22	ESIA	Gibe III Hydroelectric Project				Gibe III - Environmental and Social Impact Assessment - Executive Summary		27
23	ESIA	Gibe III Hydroelectric Project				Resettlement Action Plan - Executive Summary		34
24	ESIA	EEPCO				Letter - GIBE III Environmental and Social Impact Assessment Report	28-juil-08	2
25	ESIA	EEPCO				Comments on Dowstream Impact Assessment, Resettlement Action Plan /RAP/; Public Consultation and Disclosure Plan /PCDP	28-juil-08	4
26	EFTA	European Investment Bank	African Development Bank	World Bank Group		Gibe III - Economic, Financial and Technical Assessment	31-juil-08	
27	NGOs	Africa Resources Working Group (ARWG)				A Commentary on the Environmental, Socioeconomic and Human Rights Impacts of the Proposed Gibe III Dam in the Lower Omo River Basin of Ethiopia in Response to the Downstream EIA	janv-09	28
28	ESIA	EEPCO				Lettre - ESIA Final Reports	20-févr-09	7
29	Regional	Wiebke Förch				Case Study: The Agricultural System of the Konso in South-Western Ethiopia	2003	15
30	Regional	UN-OCHA				Who What Where - Activities by Sector and Zone in Oromiya Region	28-nov-06	1
31	Regional	Africa Peace Forum, Ethiopian Pastoralist Research and Development Association				Addressing Pastoralist Conflict in Ethiopia: The Case of the Kuraz and Hamer Sub-districts of South Omo zone	août-05	46
32	Sectoral	?				Exemples illustres de barrages en Afrique	?	10
33	Regional	Jon Abbink				Disaster, Relief and Political Change in Southern Ethiopia: Developments from within Suri Society	?	11
34	Sectoral	Anna Brismar				Attention to impact pathways in EISs of large dam projects	2004	29
35	Regional	Cordaid	Forum for Social Studies			Community Perspectives on Climate Change Impacts and the Responses in the Southern Lowlands of Ethiopia	juin-09	25
36	Regional	?				Ethiopia's Path to Survival and Development: Investing in Water Infrastructure	?	15
37	NGOs	Anuak Justice Council	Bank Information Center	Campagna per la Riforma della Banca Mondiale	International Rivers	Request for CRMU Compliance Review and Investigation of the Bank's Gibe III dam Project (Ethiopia)	22-avr-09	12
38	Sectoral	UNDP				Dams and Large Scale Irrigation on the Senegal River. Impacts on Man and the Environment	2006	24
39	Sectoral	W. M. Adams				The Downstream Impacts of Dam Construction: A Case Study from Nigeria	1985	12
40	Sectoral	Global Environmental Change (journal)				Environmental and Social Impacts of Large Scale Hydroelectric Development: Who Is Listening?	1995	22
41	Regional	USAID				Ethiopia - Complex Emergency - Situation Report 3	11-juin-08	4
42	Regional	USAID	World Food Programme (WFP)	FEWS Net		Ethiopia - Food Security Update	août-09	9
43	Regional	USAID	World Food Programme (WFP)	FEWS Net		Ethiopia - Food Security Outlook	avr-09	8
44	Sectoral	Journal of Environmental Management				Exporting dams: China's hydropower industry goes global	2008	9
45	NGOs	Anthony Mitchell				Gibe III Dam Heralds Climate Change Conflicts in Africa	juin-09	5
46	NGOs	Campagna per la Riforma della Banca Mondiale	CEE Bankwatch Network			The Gilgel Gibe II hydroelectrical poject, a case of super-tied aid	?	6
47	Regional	Save The Children UK				Ethiopia Food Economy Map	?	7
48	Sectoral	Danish Journal of Geography				Flood recession agriculture in the Senegal River Valley	2003	16
49	Regional	Oxfam - Pastoral Programme				Food Security Situation in the Pastoral Areas of Ethiopia	2003	15
50	NGOs	?				Gibe III NGOs information	?	2

	Category	Mandated by / Author				Title	Date	Pages
51	Regional	Environmental Geology				Analyzing the effects of historical and recent floods on channel pattern and the environment in the Lower Omo basin of Ethiopia using satellite images and GIS	2009	14
52	Regional	Ivo Strecker				Five Proposals for Hamar Relief and Development presented to Redd Barna Ethiopia	1987	19
53	Sectoral	Environmental Impact Assessment Review				Health Impacts of Large Dams	1999	11
54	Sectoral	International Rivers				Social and Environmental Standards for Large Dams	déc-08	29
55	Sectoral	IIED	Global Water Initiative			Introducing local benefit sharing around large dams in West Africa. Drawing on regional and International experience	févr-09	39
56	NGOs	International Rivers				Lowering the Bar on Big Dams. Making a Case for WCD Compliance on African Dams	juil-07	23
57	NGOs	International Rivers				Fact Sheet: Gibe III Dam, Ethiopia	mai-09	9
58	NGOs	International Rivers				Facing Gibe 3 Dam: Indigenous Communities of Ethiopia's Lower Omo Valley	26-janv-09	10
59	Regional	USAID				Fact Sheet - The South Omo - Turkana Cross Border Conflict Mitigation Initiative	01-avr-06	3
60	Regional	Journal of Arid Environments				Quantifying hydrologic impacts following dam construction along the Tana River, Kenya	2002	27
61	Regional	GIWA				Regional Assessment - East African Rift Valley Lakes	?	80
62	Sectoral	WMO/GWP Associated Programme on Flood Management				Mauritania: Managed Flood Releases and Livelihoods - Lower Delta Senegal River	?	4
63	NGOs	Campagna per la Riforma della Banca Mondiale	Les Amis de la Terre	International Rivers	Rainforest Action Network	Letter - Re: Gilgel Gibe III Hydropower Dam, Ethiopia	14-janv-08	4
64	Regional	Future Agriculture				Pastoral Innovation Systems Perspectives from Ethiopia and Kenya	2009	20
65	Regional	Drylands Coordination Group				Pastoralists in Southern Ethiopia:Dispossession, Access to Resources and Dialogue with Policy Makers	oct-08	49
66	Regional	USAID	World Food Programme (WFP)	FEWS Net		Ethiopia Food Security Outlook. July to December 2009	déc-09	10
67	Regional	Farm Africa				Soil Fertility Practices in Wolaita Zone, Southern Ethiopia: Learning from Farmers	mars-05	34
68	Sectoral	Communist and Post-Communist Studies				Resettlement for China's Three Gorges Dam: socio-economic impact and institutional tensions	2000	19
69	Sectoral	Ecology and Society				Restoring Environmental Flows by Modifying Dam Operations	2007	26
70	Regional	World Food Programme				A review of emergency food security assessment practice in Ethiopia	2006	64
71	NGOs	WWF				Rivers at Risk. Dams and the future of freshwater ecosystems	1986	48
72	NGOs	Survival International				Letter to the director of ADB - Gilgel Gibe III Hydroelectric Power Project	09-avr-09	20
73	Sectoral	Impact Assessment and Project Appraisal				Social impact assessments of large dams throughout the world: lessons learned over two decades	sept-03	10
74	Sectoral	Journal of Environmental Management				Social impacts of large dam projects: A comparison of international case studies and implications for best practice	2009	9
75	Sectoral	UN EUE				South Omo: pocket areas requiring food aid, overall situation necessitates close monitoring into 2003	oct-02	8
76	NGOs	Survival International				Letter to the executive director of ADB	18-août-09	3
77	NGOs	Anthony Mitchell				Gilgel Gibe III Economic, Technical and Engineering Feasibility - Desk Study Report Submitted to the African Development Bar	15-avr-09	10
78	Regional	University of Wyoming				Upstream Dams and Downstream Water Allocation. The Case of the Hadejia'Jama'are Floodplain, Northern Nigeria	07-nov-02	31
79	Regional	University of Mainz				Women's Worlds in Dassanetch, Southern Ethiopia	2005	195
80	Sectoral	IPTRID				Smallholder irrigation technology: Prospects for Sub-saharian Africa	mars-01	45
81	ESIA	?				Gibe III – Cumulative Impact Assessment Study. Terms of Reference – second draft 2 December 2009 clean copy	02-déc-09	3
82	ESIA	?				Terms of Reference for Consultations with the Lake Turkhana Communities 1	?	4
83	ESIA	?				Terms of Reference for Consultations with the Lake Turkhana Communities 2	?	4
84	ESIA	?				TORs - ESIA for Lake Turkana	24-nov-09	5
85	ESIA	?				Annex 1 - Assessment of Hydrological Impacts of Ethiopia's Gibe III Hydro Project on Kenya's Lake Turkana Water Levels	?	7
86	EFTA	European Investment Bank	Sogreah Consultants	AG Consult	Mott Mac Donald	Gibe III - Draft EFTA Study Report - Economic, Financial and Technical Assessment – Volume 1	juil-09	161
87	EFTA	European Investment Bank	Sogreah Consultants	AG Consult	Mott Mac Donald	Gibe III - Draft EFTA Study Report - Economic, Financial and Technical Assessment – Volume 2	juil-09	171
88	EFTA	European Investment Bank	Sogreah Consultants	AG Consult	Mott Mac Donald	Gibe III - Draft EFTA Study Report - Economic, Financial and Technical Assessment – Volume 3	juil-09	88
89	EFTA	European Investment Bank	Sogreah Consultants	AG Consult	Mott Mac Donald	Gibe III - Draft EFTA Study Report - Economic, Financial and Technical Assessment – Appendices	juil-09	81
90	EFTA	European Investment Bank	Banque Africaine de Développement	Mott Mac Donald	Sogreah Consultants	Gibe III - Economic, Financial and Technical Assessment - Inception Report	mars-09	82
91	EFTA	Mott Mac Donald	Sogreah Consultants	AG Consult		Gibe III - Economic, Financial and Technical Assessment - Inception Report (content)	mars-09	17
92	EFTA	?				Gibe III - Economic, Financial and Technical Assessment - Inception Report	?	17
93	EFTA	European Investment Bank	Sogreah Consultants	AG Consult	Sogreah Consultants	Gibe III - Economic, Financial and Technical Assessment Technical appraisal – Plant Design and Technology	?	100
94	EFTA	Mott Mac Donald	Sogreah Consultants			Gibe III - Civil Works - Assessment Report June 2009	juin-09	14
95	Regional	La Lettre de l'Océan Indien				La Lettre de l'Océan Indien	12-déc-09	8
96	NGOs	No Water No Life				River Omo Basin - Expedition '08 Report Summary	2008	
97	Regional	Jimma University	Brown University			Policy Brief 21 - Knowledge of HIV/AIDS Preventive Behaviors among Youth in the Gilgel Gibe Dam Area	juil-07	2
98	NGOs	International Rivers				Ethiopia's Gibe 3 Dam: Sowing Hunger and Conflict	?	8
99	NGOs	Addis Fortune				Gilgel Gibe III Tug of War	17-mars-09	9
100	Guidelines	African Development Bank - The Independent Review Mechanism				Annual Report 2008	2009	50
101	Guidelines	African Development Bank - The Independent Review Mechanism				RE: Request for Compliance Review and Mediation (Response of Director CRMU to NGOs)	22-juil-09	7
102	Guidelines	African Development Bank - The Independent Review Mechanism				Request Register Of the Indemendent Compliance Mechanism - Request No. RQ 2009/1b	août-09	2

Appendix [2] - List of persons interviewed

Appendix [3] - Results of water quality analysis

RESULTS OF WATER QUALITY ANALYSIS FROM ESIA STUDIES

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Water Works
Design and
Water Quality
P.O.Box 2561

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e-mail w.w.d.s.e@telecom.net.et

Addis Ababa
Ethiopia

SELECTED PHYSIO CHEMICAL AND BACTERIOLOGICAL WATER ANALYSIS RESULTS ID. NO

Client/Project: Mid-Day International Consuting Engineers **Test Method:**

SOURCE OF SAMPLE	River	River	River	River	
LOCATION	–	–	–	–	
DATE OF COLLECTION	–	–	–	–	
DATE RECEIVED	25/04/06	25/04/06	25/04/06	25/04/06	
CLIENTS ID.NO.	Omo River near Mudla	Gojeeb	Omo River at the bridge	Omo River at GG-III Dam site	
LAB.ID NO.	817/98	818/98	819/98	820/98	
Colour (app)	–	–	–	–	
Turbidity (NTU)	198.0	57.0	218.0	116.0	
Total Solids 105 ^{0}C (mg/l)	353.0	100	388.0	346.0	
T. Dissolved Solid 105^{0}C(mg/l)	70.0	84.0	78.0	82.0	
Electrical Conductivity (µS/cm)	109.9	130.1	104.7	126.1	
P^H	7.34	7.37	7.33	7.5	
Ammonia (mg/l NH_3)	0.125	0.56	0.160	0.188	
Sodium (mg/l Na)	4.6	7.0	5.4	6.7	
Potassium (mg/l K)	2.9	4.9	3.2	3.6	
Total Hardness (mg/l Ca CO_3)	50.0	52.8	57.2	52.8	
Calcium (mg/l Ca)	10.6	13.2	12.3	14.08	
Magnesium (mg/l Mg)	5.94	4.86	6.48	4.32	
Total Iron (mg/l Fe)	2.04	0.96	2.9	0.76	
Manganese (mg/l Mn)	0.15	0.17	0.18	0.15	
Fluoride (mg/l F)	Trace	0.235	Trace	0.235	
Chloride (mg/l Cl)	2.82	2.82	1.88	1.88	
Nitrite (mg/l NO_2)	Trace	Trace	0.03	Trace	
Nitrate (mg/l NO_3)	1.19	1.19	1.6	1.0	
Alkalinity (mg/l $CaCO_3$)	49.14	56.7	47.25	56.7	
Carbonate (mg/l CO_3)	Trace	Trace	Trace	Trace	
Bicarbonate (mg/l HCO_3)	59.95	69.17	57.65	69.17	
Sulphate (mg/l SO_4)	5.3	4.75	15.4	4.75	
Phosphate (mg/l PO_4)	0.948	0.595	1.58	0.759	
REMARK:-					

Checked by: ____ Date: 10/05/06

Approved by: ____ Date: 10/05/06

Appendix [4] - EPA Approval letter of the ESIA study

Re. 23/07/08
12.61/2000

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የአከባቢ ጥበቃ ባለሥልጣን
The Federal Democratic Republic of Ethiopia
ENVIRONMENTAL PROTECTION AUTHORITY

ቀን 23 JUL 2008
Date
ቁጥር: 2/MD-AT-3/124
Ref. No.

Ethiopian Electric Power Corporation (EEPCo)

Addis Ababa

Subject: Approval of GIBE III Hydroelectric Project's Environmental and Social impact Assessment Report

Dear Sir,

We have studied the said report in the caption with ample interest. We have come to note that:

- the project, its biophysical, socio-economic and cultural conditions are sufficiently described,
- references are made to the key applicable polices, legal framework and institutional matters,
- the project benefits are pointed out,
- the potential adverse impacts are identified and fairly analysed,
- findings of consultation with interested and affected parties are outlined,
- the Environmental and Management Plan (EMP), monitoring activities are proposed and the necessary budget and implementation mechanisms are indicated.

Accordingly, the federal Environmental Protection Authority agrees to the implementation of the project with conditions that EEPCo will commit itself to;

- establish the environmental unit and the necessary capacities to implement the dictates of the EMP and monitoring activities,
- the proper implementation of the EMP and the monitoring activities,
- regularly report to EPA, the concerned regional environmental agencies and other stakeholders on the environmental performance of the project,
- notify EPA and other stakeholders about the occurrences of unforeseen events, outstanding issues that might arise during planned public disclosure, and take appropriate measures accordingly,

☎ 251-011-6 46 5007
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251-011-646 4898
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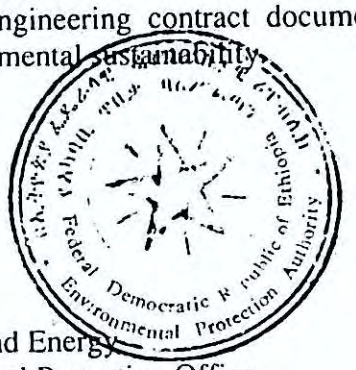
Website: www.epa.gov.et

- make the necessary arrangement for EPA and other stakeholders for joint field monitoring of the environmental performance of the project,
- recruit separate and competent institutions to implement the EMP, to undertake audit, that are independent and different from the engineering contractors,
- include in the engineering contract document provisions on the obligation of ensuring Environmental Sustainability.

With regards,

Solomon Kebede

Head, Impact Assessment Service



Cc:

- Ministry of Mines and Energy
- Oromia Environmental Protection Office
  Addis Ababa
- SNNPR Environmental Protection Land Administration and Use Authority
  Awassa

Appendix [5] - Results of previous soil surveys

Lower Omo Soil Surveys Main Results.

Soil mapping unit	FAO 1988 classes		Current suitability	Remedial measures	Future suitability	Area ha
Fs	HAPLIC ARENOSOL	Sandy soils with gravel horizons of active alluvial fans	N2		N2	3469
Fm1	EUTRIC REGOSOL	Loamy soils often with gravel horizons on alluvial fans	S3x		S3x	12070
Fm2	EUTRIC REGOSOL sodic, salic & inundic phases	Loamy soils with some salinity and sodicity of alluvial fans	S3n		S3n	1659
Fmz	EUTRIC REGOSOL sodic phase	Sodic loamy soils on alluvial fan bottom slopes	S2nw	gypsum	S2t	822
Ss	HAPLIC ARENOSOL	Sandy soils with shell beds on old beach ridges	N2		N2	1287
Ah1	EUTRIC REGOSOL gilgaï phase	Heavy soils, no crevassing, many channels	S2dt	surface drainage	S2t	3382
Ah2	EUTRIC REGOSOL	Heavy soils, some crevassing	S21	crevasse infilling	S1	5254
Ah3	EUTRIC REGOSOL inundic phase	Heavy soils with waterlogging, alluvial fan base	S3w	surface drainage	S2d	903
Ah(z)1	EUTRIC REGOSOL sodic phase	Heavy, sodic, alluvial soils	N1d	subsoil drainage	S2d	2501
Ah(z)2	EUTRIC REGOSOL sodic, salic & inundic phases	Heavy, sodic, alluvial soils in dissected topography	N1d		N1d	1844
Am1	EUTRIC REGOSOL	Stratified, loamy alluvial soils, severe crevassing	S3t	crevasse infilling	S2a	12457
Am2	EUTRIC REGOSOL inundic phase	Stratified, loamy alluvial soils, no crevassing	S2a		S2a	16050
Am3	EUTRIC REGOSOL sodic phase	Stratified, loamy alluvial soils, waterlogged, little crevassing	S3d	surface drainage	S2a	1112
Am4	SODIC SOLONCHAK	Stratified loamy and heavy alluvial soils, vertisols	S2d		S2d	5121
Am(z)1	EUTRIC REGOSOL sodic phase	Stratified, sodic, loamy alluvial soils	S3n	gypsum	S2d	5009
Am(z)2	EUTRIC REGOSOL sodic phase	Stratified, sodic loamy alluvial soils in dissected topography	N2		N2	1910
Av1	EUTRIC VERTISOL	Vertisols	N1d	subsoil drainage	S2d	2078
Av2	EUTRIC VERTISOL sodic phase	Vertisols of drainage lines	N1d		N1d	3010
Av3	EUTRIC VERTISOL	Complex of vertisols and heavy alluvial soils	N1d	subsoil drainage	S2d	3874
Av/l	EUTRIC VERTISOL sodic phase	Vertisols abruptly over stratified lacustrine sediments	N1d	subsoil drainage	S2d	6633
Az1	HAPLIC SOLONETZ	Sodic and saline soils with structural degradation	N2		N2	2066
Az2	HAPLIC SOLONETZ salic phase	Sodic and saline soils with structural degradation, waterlogged	N1d		N1d	1422
Az3	CALCIC SOLONETZ	Sodic soils with structural degradation	N2		N2	5703
Total						99636

Limiting factors	**Remedial measures**	Area ha
x = excessive drainage	D = Subsurface drainage	15716
n = soil toxicity	C = Crevasse Infilling	17711
t = topography	S = Surface drainage	5477
d = poor drainage	G = Gypsum addition	5831
w = surface waterlogging		
a = available moisture due to stratification		

Appendix [6] - Data on Kebele population, ethnicity and use of Omo River for recession agriculture and grazing

List of kebeles for the 4 downstream woredas with recession agriculture and grazing land, population and ethnic groups.

Dassenech Woreda

No.	Kebele	Recession agriculture at Omo River	Grazing land flooded by Omo River	No recession agriculture or grazing land
1	Rate	995		
2	Borconech	938		
3	Lobet	1,336		
4	Terengere	900		
5	Alketetach	1,022		
6	Kelewei	974		
7	Nymmeri	1,346		
8	Kelem	636		
9	Akodongori	No data		
10	Kerewo	1,023		
11	Kolomejoto	1,390		
12	Lotchober	1,361		
13	Selen	1,005		
14	Lomaliya[Lomseya]	1,492		
15	Edjangalok	1,101		
16	Abiyayani	1,638		
17	Gumbubur	1,086		
18	Gumbubur nebremus	1,122		
19	Libemuket	2,157		
20	Arsiyamoi	1,093		
21	Bayu	848		
22	Siremeret	998		
23	Toltali	1,278		
24	Rukruk	998		
25	Delejmur	2,373		
26	Delerilei	1,023		
27	Edboren / Diba	1,956		
28	Arikol	1,005		
29	Gorenarama		1,352	
30	Lokoro		1,095	
31	Fegege		1,369	
32	Ocholech		2,438	
33	Merkei		1,452	
34	Bubua		1,536	
35	Bandera		1,089	
36	Dobei		No data	
37	Nakiya		1,222	
38	Ado		2,242	
39	Langai		1,364	
40	Omorate	2,835		
41	Desne			1,611
42	Abudengoi			1,911
TOTAL		**54,610**	**35,929**	**15,159**	**3,522**
Relative Share		**100%**	**66%**	**28%**	**6%**

Hamer Woreda

No.	Kebele	Recession agriculture at Omo River	No recession agriculture at Omo River	Ethnic group
1	Erbore Gondereba		2,101	
2	Erbore Egade		228	
3	Erbore Merle		818	Erbore
4	Erbore Kulema		606	
5	Erbore Kaysa		910	
6	Kara Lebuk	423		
7	Kara Dus	944		Kara
8	Kara Korocho	426		
9	Zegerma		1,228	
10	Cherkeka		1,268	
11	Erya Umbrale		801	
12	Achei Algonei		990	
13	Achei Musa		902	
14	Shanko Welfo		1,110	
15	Shanko Kelema		1,255	
16	Mirsha Kusoma		1,594	
17	Morsha Beta Gelefa		1,871	
18	Dega Kefa Alea		1,302	
19	Dega Kefa Olgan		1,370	
20	Genbela		1,386	
21	Kola Keja		2,038	Hamer
22	Wero		1,938	
23	Senbele		2,705	
24	Beshada		2,970	
25	Denbeyti		1,270	
26	Lala		1,886	
27	Gejbak		2,266	
28	Angade		5,636	
29	Merogelti		3,932	
30	Wengebayno		2,978	
31	Aseli		6,909	
32	Kufr		1,258	
33	Bonkololagi		907	
34	Zelekata		2,363	
35	Dimeka		760	
Total	**61,349**	**1,793**	**59,556**	
Relative share	**100%**	**3%**	**97%**	

Nyangatom Woreda

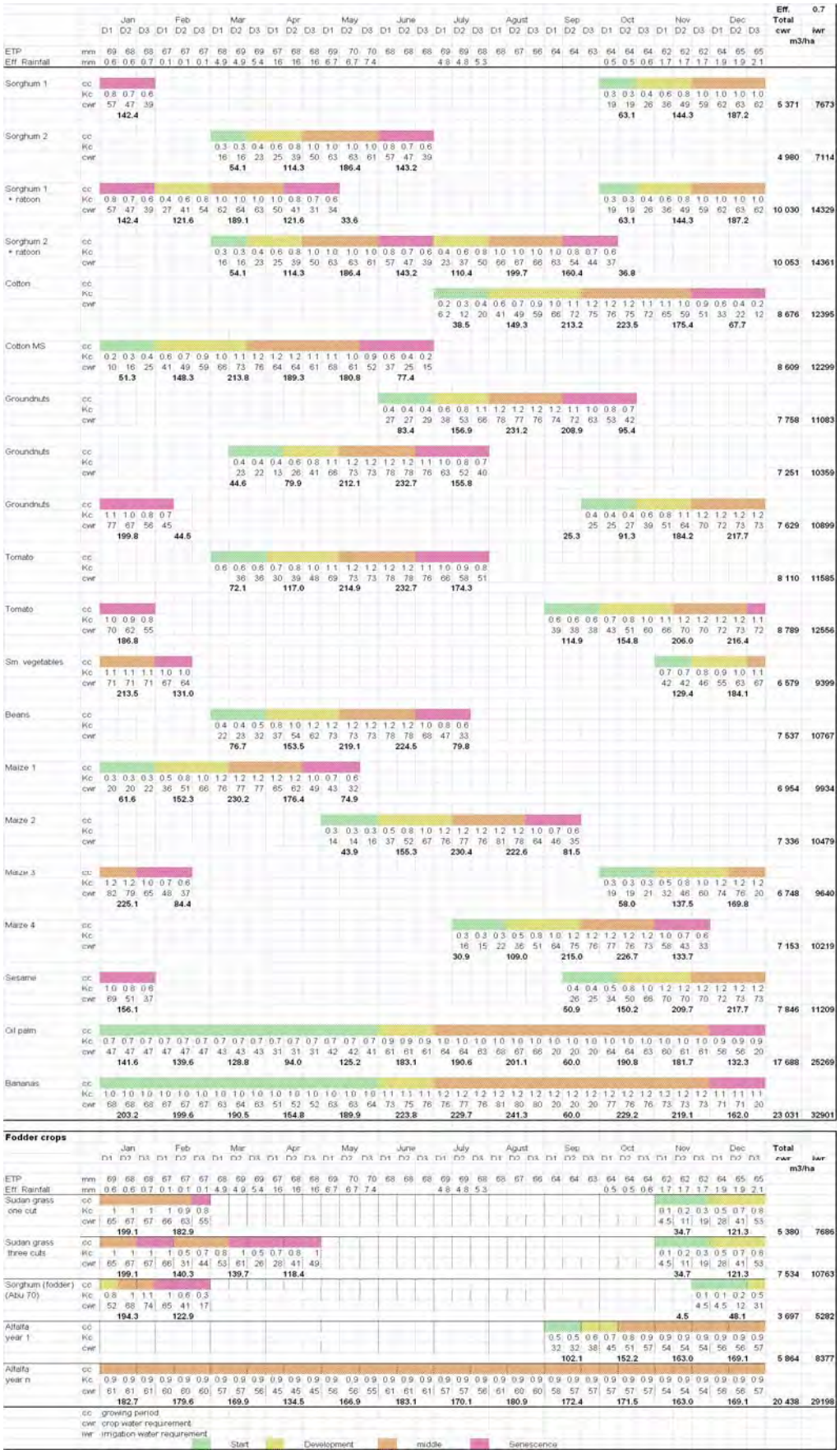
No.	Kebele	Kebeles around Omo River	Kebeles around Kibish River	Ethnic group
1	Kangaten	1,650		Nyangatom
2	Narogoy	2,119		
3	Kuchuru	1,974		Muguji
4	Ayipa	1,469		Murile
5	Lopokor	1,487		Nyangatom
6	Kawtomen		2,105	
7	Nawuyappi		1,027	
8	Chare	1,481		
9	Lebere		1,077	
10	Naptokait	831		
11	Shenkora	1,225		
12	Lornkachew	1,348		
13	Kopiryayi	1,008		
14	Lokolem		1,081	
15	Kajamakin		1,481	
16	Lokornakce		1,252	
17	Nabiryaman	965		
18	Natikar		1,982	
19	Kakuta		1,646	
20	Lotomen		1,487	
Total	**28,695**	**15,557**	**13,138**	
Relative share	**100%**	**54%**	**46%**	

Selamago Woreda

No.	Kebele	Practice recession agriculture	Do not practice recession agriculture	Ethnic group
1	Dime Gero		X	Dime
2	Dime Ganchire		X	
3	Dime Gerfa		X	
4	Dime Erka		X	
5	Dime Utsa		X	
6	Dime Gecha		X	
7	Tsitsima		X	Bodi, with some Konso settlers
8	Kanchiwa		X	
9	Shumuto		X	
10	Dakuwa		X	
11	Arom		X	
12	Narmashik	X		Bodi
13	Giyo	X		
14	Omorombei	X		
15	Gura	X		
16	Omohana	X		Bacha (Muguji)
17	Harylwa	X		Mursi
18	Moyzo	X		
19	Bongozo	X		
20	Maki	X		
Total	**28,888**	**13,000**	**15,888**	
Relative share	**100%**	**45%**	**55%**	

Appendix [7] - Crop water requirements

Crop Water Requirements.



Irrigation Water Requirements – Cropping Patterns

Extensive cropping pattern 1 - Sorghum/maize/beans/vegetables/sesame/bananas
Crop water requirements at the farm gate - Irrigation effiency : 70%

	%	Jan	Feb	Mar	Apr	May	June	July	Agust	Sep	Oct	Nov	Dec	Total
Sorghum	30%	610									271	619	802	2302
Sesame	5%	111								36	107	150	156	560
Maize	40%	35	870	1316	1008	428								3657
Beans	10%			110	219	313	321	114						1077
Vegetables	5%	152	94									92	132	470
Tomato	5%			51	84	154	166	124						579
Bananas	5%	145	143	136	111	136	160	164	172	43	164	156	116	1645
Total	100%													
m3/ha		943	1106	1613	1422	1030	647	403	172	43	434	867	1050	9730
l/s/ha		0.39	0.46	0.67	0.59	0.43	0.27	0.17	0.07	0.02	0.18	0.36	0.43	0.34

Extensive cropping pattern 2 - Sorghum/maize/beans/vegetables/bananas
Crop water requirements at the farm gate in m3/ha - Irrigation effiency : 70%

	%	Jan	Feb	Mar	Apr	May	June	July	Agust	Sep	Oct	Nov	Dec	Total
Sorghum (2h)	30%	610	521	810	521	144					271	619	802	4299
Maize	40%					251	887	1316	1272	465				4192
Beans	15%			164	329	469	481	171						1615
Vegetables	5%	152	94									92	132	470
Tomato	5%			51	84	154	166	124						579
Bananas	5%	145	143	136	111	136	160	164	172	43	164	156	116	1645
Total	100%													
m3/ha		908	757	1162	1045	1153	1694	1776	1445	508	434	867	1050	12900
l/s/ha		0.38	0.31	0.48	0.43	0.48	0.70	0.73	0.60	0.21	0.18	0.36	0.43	0.44

Semi-intensive cropping pattern 2 - Sorghum/maize/beans/vegetables/bananas
Crop water requirements at the farm gate - Irrigation effiency : 70%

	%	Jan	Feb	Mar	Apr	May	June	July	Agust	Sep	Oct	Nov	Dec	Total
Sorghum	30%	610	521	810	521	144					271	619	802	4299
Maize	50%	1608	603								414	982	1213	4820
Beans	15%			164	329	469	481	171						1615
Vegetables	10%	305	187									185	263	940
Tomato	10%			103	167	307	332	249						1159
Bananas	5%	145	143	136	111	136	160	164	172	43	164	156	116	1645
Total	120%													
m3/ha		2668	1453	1049	963	916	962	894	343	43	849	1942	2394	14477
l/s/ha		1.10	0.60	0.43	0.40	0.38	0.40	0.37	0.14	0.02	0.35	0.80	0.99	0.50

Intensive cropping pattern - Sorghum/maize/beans/vegetables/bananas
Crop water requirements at the farm gate - Irrigation effiency : 70%

	%	Jan	Feb	Mar	Apr	May	June	July	Agust	Sep	Oct	Nov	Dec	Total
Sorghum (2h)	30%	610	521	810	521	144					271	619	802	4299
Maize	45%				282	998	1481	1431	524					4716
Maize	45%	1447	542								373	884	1091	4338
Beans	15%			164	329	469	481	171						1615
Vegetables	5%	152	94									92	132	470
Tomato	5%			51	84	154	166	124						579
Bananas	5%	145	143	136	111	136	160	164	172	43	164	156	116	1645
Total	150%													
m3/ha		2355	1300	1162	1327	1901	2288	1891	696	43	807	1751	2141	17662
l/s/ha		0.97	0.54	0.48	0.55	0.79	0.95	0.78	0.29	0.02	0.33	0.72	0.89	0.61

Appendix [8] - Salini environmental Policy and OSHAS & ISO 14001 certification

Environmental Protection Policy

Salini Costruttori S.p.A., leader on a national and international scale in the design and implementation of civil, industrial and infrastructural works, recognises the utmost importance of environmental protection in business activities and pursues the objective of continuously improving the company's environmental management system.

Environmental protection is an integral part of company's financial and operative performance and is a prime means for reaching strategic goals in an extremely competitive global market.

The company therefore intends to actively promote all actions addressed to Employees, Customers, Suppliers, Authorities and Interested Parties aimed at reaching the highest environmental protection and conservation standards.

The environmental protection objectives to which Salini Costruttori S.p.A. attributes the utmost importance are:

- to protect the environment and to prevent environmental damage by applying good practices and operating instructions which have as little effect as possible on the environment;
- to identify and to assess environmental aspects of company's activities, to ascertain those aspects that have or can have significant impact(s) on the environment;
- to comply with the applicable legal requirements and with other requirements subscribed and/or adopted by the Company and to apply the strictest standards wherever possible.

The company aims at reaching these objectives by:

- developing and implementing an environmental management system which complies with the requirements stated in ISO 14001:2004;
- establishing, implementing and maintaining environmental targets and objectives;
- guaranteeing the availability of adequate resources (human, technical and financial) for developing and implementing the environmental management system;
- promoting an environmental protection culture within the company in line with the stated objectives.
- training employees on environmental subjects;
- indentifying and planning operations to avoid, reduce and/or control environmental impacts;
- ensuring a rational and sustainable use of natural resources (e.g. water, energy and raw materials);
- guaranteeing nature protection, social development and respect for the culture of the local communities where Salini Costruttori S.p.A. operates;
- circulating the company's Environmental Protection Policy to all members of staff and interested parties;

All Salini Costruttori S.p.A. employees are directly responsible for applying this Policy.
The company will be responsible for reviewing and improving this Policy and verifying its implementation.

Rome, July 2009

Pietro Salini
Managing Director

Certificate N. IT09/0724

The Health and Safety Management System of:

SALINI COSTRUTTORI S.p.A.

Via della Dataria, 22 - 00187 Roma - Italy.

Has been assessed and registered as meeting the requirements of:

OHSAS 18001 – Ed. 2007

For the following activities:

Design, construction and project management of buildings, large transport and hydraulic infrastructures and technological plants

EA Sector: 28

This certificate is valid from 07/08/2009 until 07/08/2012 and remains valid subject to satisfactory surveillance audits.
Re certification audit due before 27/07/2012.
Issue 1. Certified since 07/08/2009.

Authorized by
Paolo Pineschi

SGS ITALIA S.p.A. - Systems & Services Certification
Via G. Gozzi, 1/A 20129 MILANO - Italy
t + 39 02 73 93 1 f +39 02 70 10 94 89 www.sgs.com

Certificate N. IT10/0004

The environmental management system of

SALINI COSTRUTTORI S.p.A.

Via della Dataria, 22 - 00187 ROMA - Italy

has been assessed and certified as meeting the requirements of

ISO 14001 / UNI EN ISO 14001:2004

For the following activities

Design, construction and project management of buildings, large transport and hydraulic infrastructures and technological plants.

Sector EA: 28

This certificate is valid from 11/01/2010 until 11/01/2013 and remains valid subject to satisfactory surveillance audits.
Re certification audit due before 30/11/2012.
Issue 1. Certified since 11/01/2010.

Authorized by
Paolo Pineschi

SGS ITALIA S.p.A. - Systems & Services Certification
Via G. Gozzi, 1/A 20129 MILANO - Italy
t + 39 02 73 93 1 f +39 02 70 10 94 89 www.sgs.com

Appendix [9] - HSE clauses in the main contract

Appendix [10] - Content of HSE Plan

CONTENT OF THE EPC CONTRACTOR HSE PLAN

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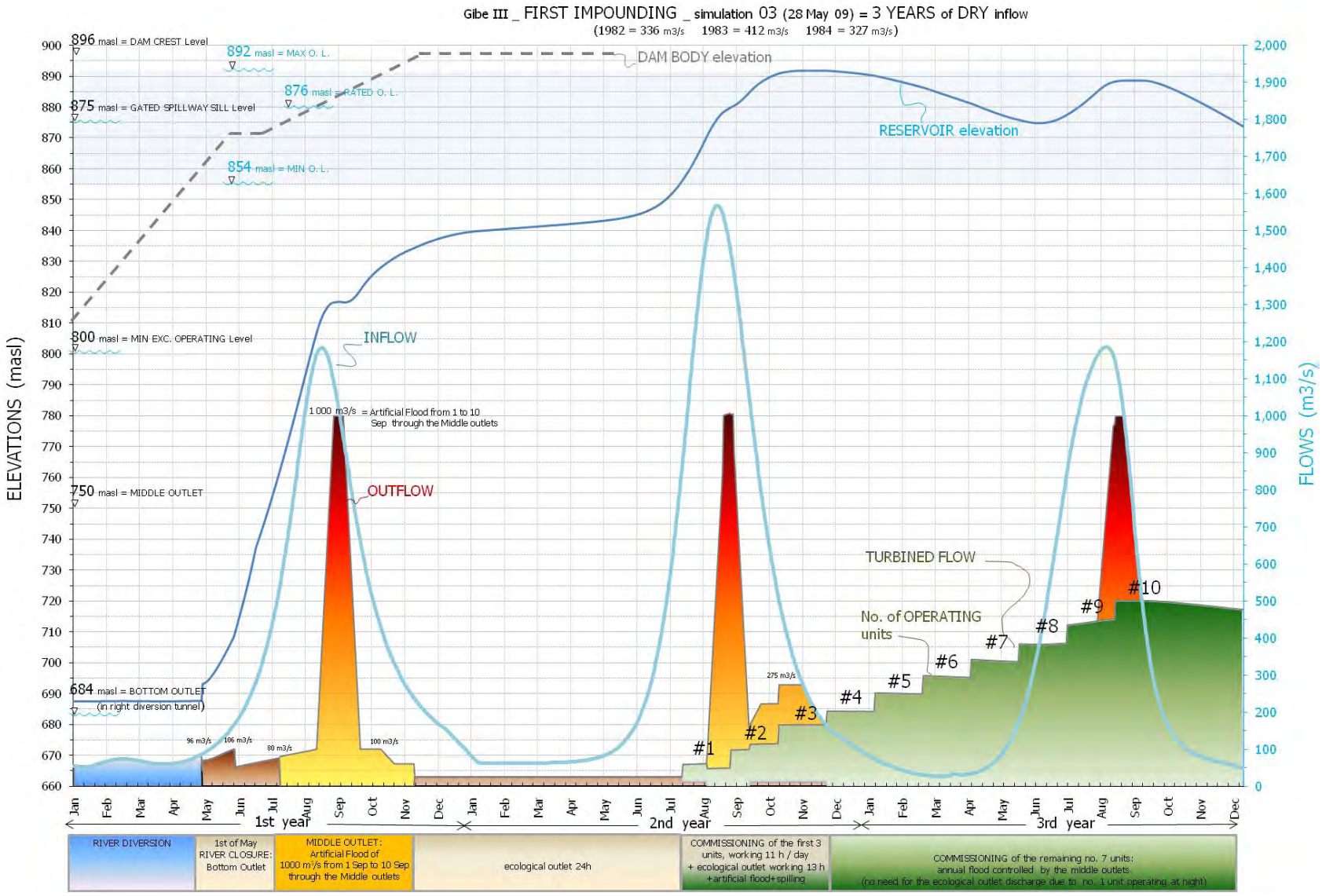
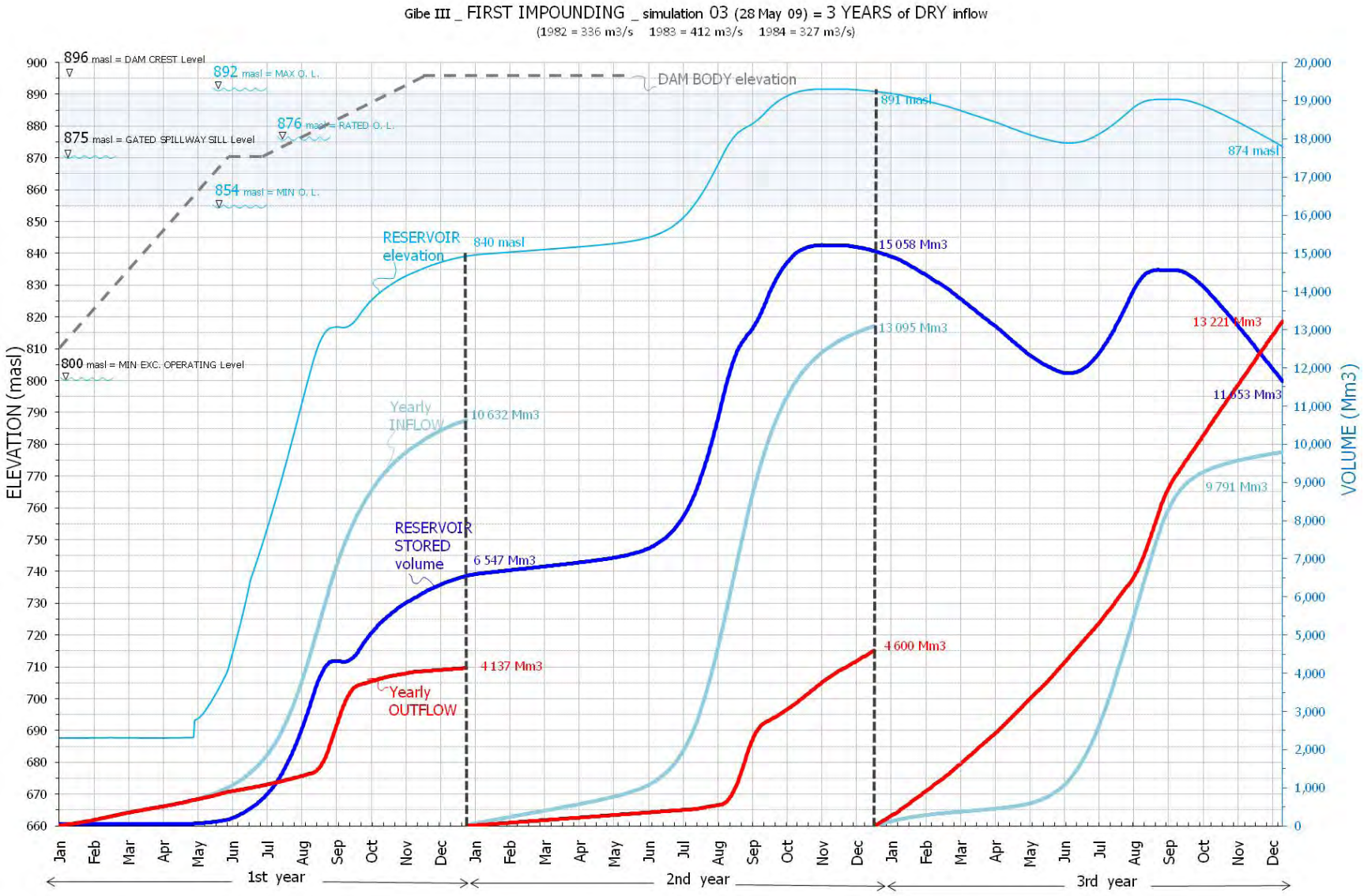
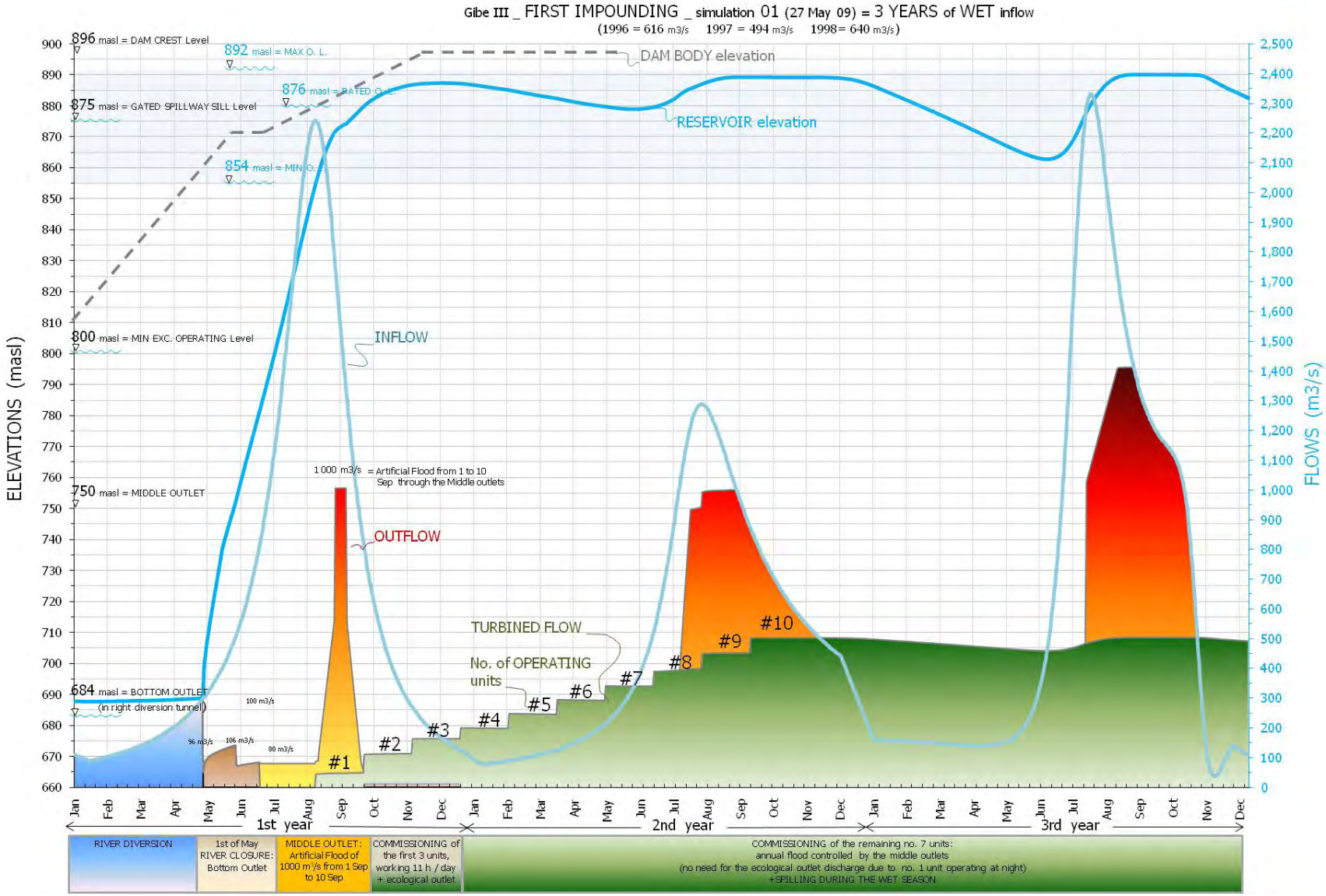
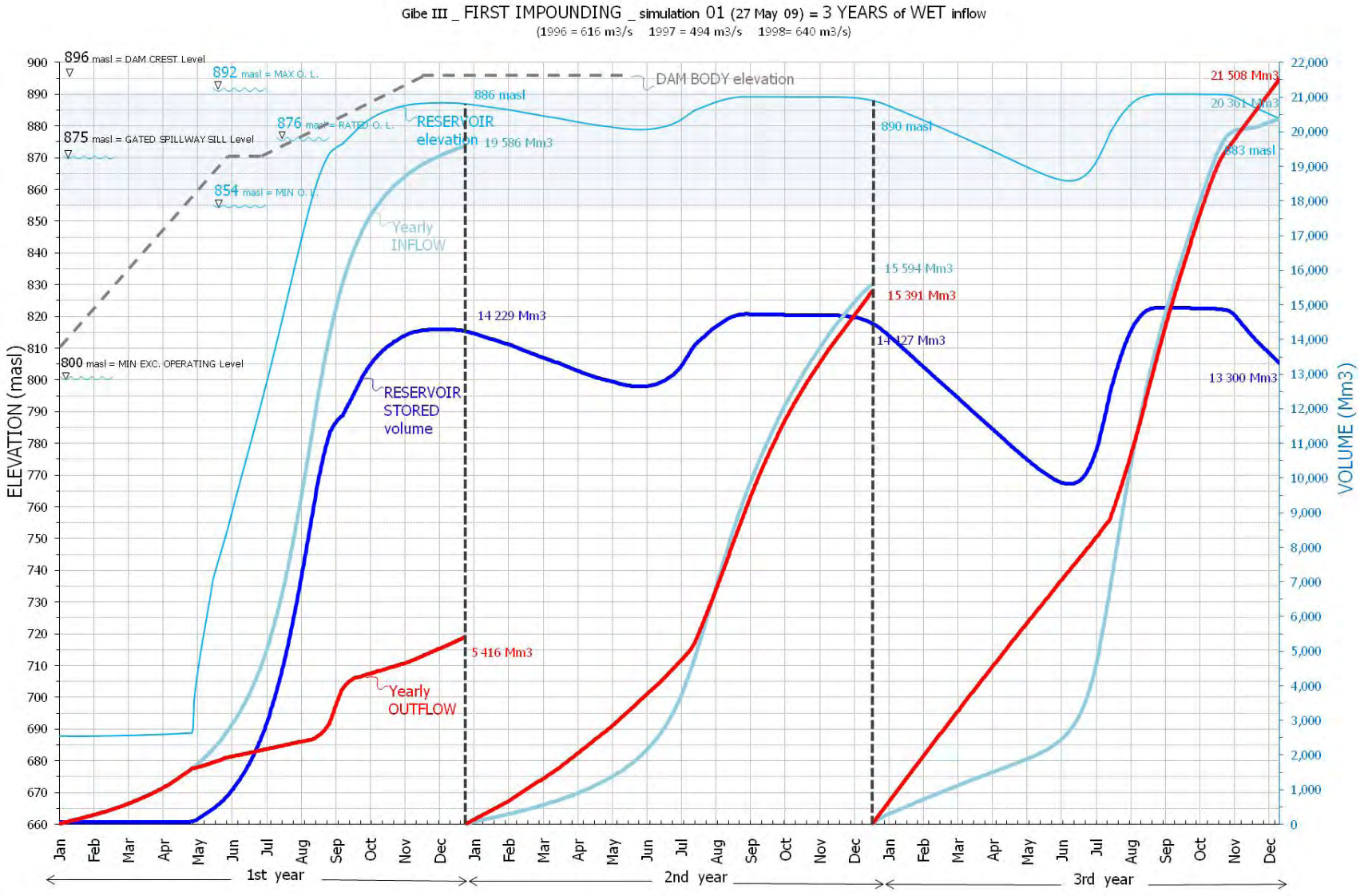
Appendix [11] - Impoundment procedures for wet and dry years


Gibe III _ FIRST IMPOUNDING _ simulation 03 (28 May 09) = 3 YEARS of DRY inflow
(1982 = 336 m3/s 1983 = 412 m3/s 1984 = 327 m3/s)
ELEVATIONS (masl)
FLOWS (m3/s)
896 masl = DAM CREST Level
892 masl = MAX O. L.
876 masl = RATED O. L.
875 masl = GATED SPILLWAY SILL Level
854 masl = MIN O. L.
800 masl = MIN EXC. OPERATING Level
750 masl = MIDDLE OUTLET
684 masl = BOTTOM OUTLET (in right diversion tunnel)
DAM BODY elevation
RESERVOIR elevation
INFLOW
OUTFLOW
1 000 m3/s = Artificial Flood from 1 to 10 Sep through the Middle outlets
TURBINED FLOW
No. of OPERATING units
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
96 m3/s
106 m3/s
80 m3/s
100 m3/s
275 m3/s
1st year
2nd year
3rd year
RIVER DIVERSION
1st of May RIVER CLOSURE: Bottom Outlet
MIDDLE OUTLET: Artificial Flood of 1000 m³/s from 1 Sep to 10 Sep through the Middle outlets
ecological outlet 24h
COMMISSIONING of the first 3 units, working 11 h / day + ecological outlet working 13 h +artificial flood+spilling
COMMISSIONING of the remaining no. 7 units: annual flood controlled by the middle outlets (no need for the ecological outlet discharge due to no. 1 unit operating at night)


Gibe III _ FIRST IMPOUNDING _ simulation 03 (28 May 09) = 3 YEARS of DRY inflow
(1982 = 336 m3/s 1983 = 412 m3/s 1984 = 327 m3/s)
896 masl = DAM CREST Level
892 masl = MAX O. L.
876 masl = RATED O. L.
875 masl = GATED SPILLWAY SILL Level
854 masl = MIN O. L.
800 masl = MIN EXC. OPERATING Level
DAM BODY elevation
891 masl
874 masl
RESERVOIR elevation
840 masl
15 058 Mm3
13 095 Mm3
13 221 Mm3
11 353 Mm3
Yearly INFLOW
10 632 Mm3
9 791 Mm3
RESERVOIR STORED volume
6 547 Mm3
4 600 Mm3
4 137 Mm3
Yearly OUTFLOW
ELEVATION (masl)
VOLUME (Mm3)
1st year
2nd year
3rd year


Gibe III _ FIRST IMPOUNDING _ simulation 01 (27 May 09) = 3 YEARS of WET inflow
(1996 = 616 m3/s 1997 = 494 m3/s 1998= 640 m3/s)
ELEVATIONS (masl)
FLOWS (m3/s)
896 masl = DAM CREST Level
892 masl = MAX O. L.
876 masl = RATED O. L.
875 masl = GATED SPILLWAY SILL Level
854 masl = MIN O. L.
800 masl = MIN EXC. OPERATING Level
750 masl = MIDDLE OUTLET
684 masl = BOTTOM OUTLET (in right diversion tunnel)
DAM BODY elevation
RESERVOIR elevation
INFLOW
OUTFLOW
1 000 m3/s = Artificial Flood from 1 to 10 Sep through the Middle outlets
TURBINED FLOW
No. of OPERATING units
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
100 m3/s
96 m3/s
106 m3/s
80 m3/s
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1st year
2nd year
3rd year
RIVER DIVERSION
1st of May RIVER CLOSURE: Bottom Outlet
MIDDLE OUTLET: Artificial Flood of 1000 m3/s from 1 Sep to 10 Sep
COMMISSIONING of the first 3 units, working 11 h / day + ecological outlet
COMMISSIONING of the remaining no. 7 units: annual flood controlled by the middle outlets (no need for the ecological outlet discharge due to no. 1 unit operating at night) +SPILLING DURING THE WET SEASON


Gibe III _ FIRST IMPOUNDING _ simulation 01 (27 May 09) = 3 YEARS of WET inflow
(1996 = 616 m3/s 1997 = 494 m3/s 1998= 640 m3/s)
896 masl = DAM CREST Level
892 masl = MAX O. L.
876 masl = RATED O. L.
875 masl = GATED SPILLWAY SILL Level
854 masl = MIN O. L.
800 masl = MIN EXC. OPERATING Level
DAM BODY elevation
886 masl
RESERVOIR elevation
19 586 Mm3
890 masl
883 masl
21 508 Mm3
20 361 Mm3
Yearly INFLOW
15 594 Mm3
15 391 Mm3
14 229 Mm3
14 127 Mm3
13 300 Mm3
RESERVOIR STORED volume
5 416 Mm3
Yearly OUTFLOW
ELEVATION (masl)
VOLUME (Mm3)
1st year
2nd year
3rd year

Appendix [12] - Hazardous material recycling authorization from EPA

በኢትዮጵያ ፌዴራላዊ ዲሞክራሲያዊ ሪፑብሊክ
የአካባቢ ጥበቃ ባለሥልጣን
The Federal Democratic Republic of Ethiopia
ENVIRONMENTAL PROTECTION AUTHORITY

ቀን 10-02-02
Date
ቁጥር 5/5-5/14
Ref. No.

በኢትዮጵያ ኤሌክትሪክ ኃይል ኮርፖሬሽን
ለግልገል ጊቤ የኢሌክትሪክ ኃይል ማመንጫ ፕሮጀክት
አዲስ አበባ

በኢንቬስትመንት ፈቃድ ቁጥር አኢፈ8333/02 እና በአዲስ አበባ ከተማ አስተዳደር ንግድና ኢንዱስትሪ ልማት ቢሮ በምዝገባ ቁጥር 06/2/29099/02 የተመዘገበው ሀቢቴብል ቢዝነስ ሶሉሽንስ ኃ.የተ.የግ.ማ/ነበር በ9/02/2002 ዓ.ም. ለመ/ቤታችን በጻፈው ማመልከቻ ከግልገል ጊቤ የኤሌክትሪክ ኃይል ማመንጫ ፕሮጀክት የሚወጡትን ተረፈ ምርቶች በመሰብሰብ አካባቢያዊ ተቀባይነት ባለው መልኩ መልሶ ጥቅም ላይ እንደሚያውል በመግለጽ ይህንን ሥራ የሚደግፍ የትብብር ደብዳቤ እንድንጽፍለት ጠይቋል::

በመሠረቱ ተረፈ ምርቶችን መልሶ ጥቅም ላይ ማዋል የአካባቢ ብክለትን ይቀንሳል፣ የሀብት ብክነትንም ያስወግዳል:: ስለሆነም ማኅበሩ በዚህ ረገድ የሚያደርገው የሥራ እንቅስቃሴ ሊበረታታ የሚገባው በመሆኑ አስፈላጊው ትብብር እንዲደረግላቸው እየጠየቅን፣ ማኅበሩም ከፕሮጀክቱ የሚሰበስባቸውን ተረፈ ምርቶች ዝርዝር መግለጫ እና አካባቢያዊ ተቀባይነት ባለው መልኩ ስለመወገዳቸው የሚገልጽ ዘገባ ተረፈ ምርቱ ለሚገኝበት የክልል የአካባቢ ጥበቃ መ/ቤት እና ለመ/ቤታችን እንዲያቀርብ በዚህ ደብዳቤ ግልባጭ እንዲያውቁት የተደረገ መሆኑን እናስታውቃለን::

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Appendix [13] – List of mitigation & monitoring measures from ESIA

Environmental and social mitigation and compensation measures during construction phase in the reservoir, construction sites, camp sites and road areas.

No.	Potential impact	Proposed mitigation measure	Responsible entity for implementation	Cost (Birr) / (USD)*
1	Wildlife disturbance due to construction	Wildlife rescue measure	EMU	500 000 Birr / 46 833 USD
2		Minimize indiscriminate disturbance due to construction	EPC contractor	Construction
3	Loss of Wildlife Habitat	Establish buffer area + Re-vegetation of disturbed sites to provide habitats for reptiles, birds and small mammals	EMU, THPA	5 000 000 Birr / 468 327 USD
4	Conflict between wildlife and human	Training, awareness creation and patrolling	EMU, THPA	200 000 Birr / 18 733 USD
5	Wildlife Poaching	Implement strict enforcement measures; Improve enforcement patrol	WC, THPA, WMU, and local Police	No additional cost
6		Designation of alternative habitat creation on a buffer area	EMU,THPA, WARNRDB	No additional cost
7	Wildlife: poaching, loss of habitat, breading and feeding areas, Increased incidence of wild animal's attack on humans and domestic animals	● Strengthening existing protected areas along Omo river ● Develop buffer area to serve as alternative habitat ● Organize public awareness programme ● Initiating buffer area development before reservoir impoundment. ●Protection of wildlife and human conflicts	EMU,THPA, MoARD, BOARD	2 500 000 Birr / 234 164 USD
8	Increased risk of poaching	Establish rescue team to protect and save wildlife	EMU/WWC/WERT/WRT	250 000 Birr / 23 416 USD
9	Terrestrial vegetation	Restoration and rehabilitation of disturbed terrestrial vegetation Establishment of Nurseries to produce locally adoptable seedlings for reforestation of the project area	EPC Contractor	Construction
10	Terrestrial vegetation	Organize awareness creation programme for the local people	EEPCO/EMU, MOA, BoARD	Included above
11	Submergence of Chida-Sodo road and bridge	Realign road section and construction of new road.	EPC Contractor	Construction
12	Submergence of river crossings	Establish boat service at nine crossing points	EEPCO	4 500 000 Birr / 421 494 USD
13		Construction of a bridge across the Gibe river	EEPCO	15 000 000 Birr / 1 404 981 USD
14	Flooding of section of two historic walls	Initiate proper research and prepare management plan to protect, conserve and manage the remaining sites from manmade and natural hazards	EEPCO	1 500 000 Birr / 140 498 USD
15		Construct a view points with associated services like catering and information desk on both sites for tourists	EEPCO	3 000 000 Birr / 280 996 USD
16	Malaria	● Malaria vector control strategy, avoiding presence of pools of standing water, educating construction workers, etc. ● All buildings are made mosquito proof; parathyroid treated mosquito nets to workers ● Early diagnosis and treatment of patients	EPC Contractor	Construction
17	Sexually transmitted diseases including	● Awareness campaign on STM and their prevention; media campaigns ● Make condoms available	EPC Contractor; EMU	Construction
18		Distribution of anti-retroviral treatment at the	EPC contractor,	No additional cost

No.	Potential impact	Proposed mitigation measure	Responsible entity for implementation	Cost (Birr) / (USD)*
	HIV/AIDS	nearest health centre	EEPCO, Local Health Institutions and NGOs	
19	Road safety Hazards	● Speed limitation on all haulage vehicles ● Personnel briefed on traffic regulations of construction area ●Traffic information in local community ● Inform parents to keep children away from traffic	EPC Contractor; EMU	Construction
20	Loss of 19,000 ha of natural vegetation and riverine forest	Establishing an estimated 50,000 ha of buffer area	EEPCO, local, Regional Offices, Local Administration	6 000 000 Birr / 561 992 USD
21	Loss of hot spring located in reservoir area	No direct mitigation. However, it is recommended to locate and develop new hot spring sites (if there are any) and improve or provide access roads in consultation with the affected communities.	EEPCO	1 000 000 Birr / 93 665 USD
22	Conflict between workers and local population	Maximize local hire of labour; Assign the responsibility for liaison with local communities and local authorities to a named individual to promote social integration, and the development of mutually satisfactory solutions to problems affecting local communities	EPC Contractor	Construction
23	Spontaneous settlements[1]	Prevention; Maximize local hire of labour	EPC Contractor, EEPCO, local authorities	Construction
24	Environmental Coordination	Assign environmental inspector to ensure proper implementation of mitigation measures; Conduct Environmental Training Programme for construction workers	EPC Contractor	Construction
25	?	Proper watershed management	EEPCO	4 000 000 Birr / 374 662 USD
26	Livelihood improvement	Reservoir fish resource development	?	6 000 000 Birr / 561 992 USD
27	Impacts of road construction	Compensation for loss of farmland, perennial crops / trees and for houses and other structures	EEPCO	40 900 000 Birr / 3 830 915 USD
28		Livelihood improvement	EEPCO	5 608 000 Birr / 525 276 USD
29		Social / Community Development Projects	EEPCO	78 250 000 Birr / 7 329 318 USD
	TOTAL			179 208 000 Birr/ 16 785 591 USD

* Exchange rate of 1USD=10,6763 BIRR cited in transmission line ESIA is taken

Downstream: affected communities

For measures implemented mainly during operation phase but starting in the last two years of the construction phase, see table “operation phase” (and for implementation schedule, refer to ESIA downstream p 205)

[1] No spontaneous settlement observed since 2006. Only 3 huts observed by February 2010, two of which being in the right of way of the future Chida-Sodo road.

Environmental and social mitigation and compensation measures during operation phase the reservoir, construction sites, camp sites and road areas.

No.	Potential impact	Proposed mitigation measure	Responsible entity for implementation	Cost (Birr) / (USD)*
1	Reservoir water quality deterioration	Enforce national and international quality standards	EEPCO, MoWR	Construction
2	Reservoir water quality deterioration	Remove vegetation before reservoir impounding	EEPCO, BoA, EPC Contractor	Construction
3	Catchment erosion and reservoir sedimentation; Reduction of river flow to the downstream communities	● Reforestation and re-vegetation with local adoptable species ● Keep recommended environmental discharge ● Monitor hydrologic gauge station regularly ● Establish and implement proper watershed management	EEPCO, MoWR, BOA, Local Administration	6 000 000 Birr / 561 992 USD
4	Forest and natural vegetation	Implement buffer area	EEPCO/EMU, BOA, Local Administration	1 500 000 Birr / 140 498 USD
5	Wildlife and Terrestrial Fauna	Implement recommended Wildlife management plan; Establish Cooperation with Regional Government; Strengthen existing Protected area along the Omo River Basin; Improve enforcement measures along the Buffer Area	EEPCO/EMU, BOA, Local Administration	500 000 Birr / 46 833 USD
6	Livelihood improvement	Reservoir fish resource development	?	400 000 Birr / 37 466 USD
7	Impact of road	Series of monitoring measures for road realignment project proposed in ESIA Road Report p 107-108		No budget proposed

Environmental and social mitigation and compensation measures during construction and operation phases in the downstream area.

No.	Potential impact	Proposed mitigation measure	Responsible entity for implementation	Cost (Birr) / (USD)
1	Livelihood improvement for farmers	Irrigated agriculture development package for farmers	EEPCO	40 000 000 Birr / 3 746 616 USD
2	Livelihood improvement for pastoralists	Livestock forage Development on individual irrigated agricultural holding	Federal and Region governments, community and individuals	4 000 000 Birr / 374 662 USD
3		Irrigated Forage Development Further In-Land along the Omo River (Livestock Enterprise)	Federal and Region governments, community and individuals	12 000 000 Birr / 1 123 985 USD
4		Range Developments and Management in the Omo River Delta, Dasenech woreda	Federal and Region governments, community and individuals	6 000 000 Birr / 561 992 USD
5		Improved Livestock Practices	Federal and Region governments, community and individuals	8 000 000 Birr / 749 323 USD
6	Livelihood improvement for fishermen	Fishery Support activities costs	?	2 500 000 Birr / 234 164 USD
9	Recommended Socio-Economic Development Projects	Livelihood economy diversification, training and support program	Regional and Wereda Level Agricultural and Rural Development Offices + Pastoralist Area Development Coordination Commission + partnership with local NGOs	15 000 000 Birr / 1 404 981 USD
10		Agriculture in service training program for Farmers Training Centre (FTC) personnel.	Regional and Wereda Level Agricultural and Rural Development	4 500 000 Birr / 421 494 USD

NO.	POTENTIAL IMPACT	PROPOSED MITIGATION MEASURE	RESPONSIBLE ENTITY FOR IMPLEMENTATION	COST (BIRR) / (USD)
			Offices + partnership with Ethiopian University	
11		Wereda institutions strengthening programme	Regional and Wereda Level Agricultural and Rural Development Offices + EMU + NGOs	12 000 000 Birr / 1 123 985 USD
12		Cooperative creation through specific capacity building and technical assistance program.	Regional and Wereda Level Agricultural and Rural Development Offices + Omo Microfinance institute + partnership with NGOs	20 000 000 Birr / 1 873 308 USD
13		Community awareness and regular information meetings between project management and officials from project affected Weredas to share information on water management program in the 4 affected Weredas	EMU / sub-contracted to local NGOs	3 550 000 Birr / 332 512 USD
14		Conflict prevention and resolution programs for Wereda and Kebele officials	Regional Offices + Wereda Offices + NGOs	5 000 000 Birr / 468 327 USD
15		Coordination measures for food aid	Regional and Wereda Level Agricultural and Rural Development Offices + EMU + Food Security and Emergency Preparedness Department	60 000 000 Birr / 5 619 925 USD
Total				192 550 000 Birr 18 035 274 USD

MONITORING MEASURES WITH BUDGET ESTIMATE – CONSTRUCTION AND OPERATION PHASE

NO.	PARAMETER TO BE MONITORED	LOCATION	MEASUREMENT	FREQUENCY	RESPONSIBLE ENTITY FOR IMPLEMENTATION	COST (BIRR) / (USD)
1	On-Site Erosion and Runoff	Construction sites and material borrow areas, disposal sites, access road	Observation and reporting of erosion and sediment control plan	Continuous controls and monthly reporting	EPC Contractor, EMU	Construction
2	Air Quality	At construction sites and access road and close to settlements	Observation and inspection/ sampling and analysis using portable dust analyzer	Occasionally throughout the construction period (alternating locations)	EPC Contractor, EMU	200 000 Birr / 18 733 USD
3		Trucks and machinery exhausts	Observation and inspection	Occasionally throughout the construction period	EPC Contractor, EMU	
4	Noise	Near settlements and construction sites	Portable sound level meters for measuring noise levels	Once a week and upon complaints nearby settlement and camps	EPC Contractor, EMU	500 000 Birr / 46 833 USD
5	Water quality	In the effluents from treatment facilities and at all discharge points	Measurement, sampling and analyses of relevant parameters	Monthly and upon incidents	EPC Contractor, EMU	1 500 000 Birr / 140 498 USD
6		Material storage areas	Observation and inspection	Monthly for floor Spot checks for storm water runoff		
7	Waste management	Construction sites and camp facilities	Observation and record keeping	Monthly	EPC Contractor, EMU	Construction
8	Equipment fueling and maintenance	Workshop and garage	Visual inspection	Monthly	EPC Contractor, EMU	Construction
9	Sightings of Wildlife	Construction sites and vicinity (including alignment of roads)	Observation Photographic documentation	Continuous	EPC Contractor	200 000 Birr / 18 733 USD
10	Wildlife variation in species number and Composition	Reservoir area and surrounding habitat / Buffer area	Numbers / Occurrence of wildlife	Once per month	EMU	
11	Wildlife level and hunting pressure	Reservoir area and surrounding habitat	Increase in population and animals killed	Two times a year once in six month	THPA , EMU	
12	Wildlife Poaching/ Hunting incidents	The reservoir area and the surrounding habitat	Number of wildlife killed	Once every two weeks for a year	WC, THPA, EMU	
13	Wildlife Frequency of conflict between human and wildlife	Local Communities	Number of wildlife in the buffer area	Upon incidents and once a month for two years	EEPCO, EMU, THPA	
14	Buffer areas of woodland restored	Buffer area and nearby watershed	Visual inspection, photographic documentation	Bi annually	EPC Contractor, EMU	100 000 Birr / 9 366 USD
15	Buffer area the density of trees increased	Buffeer area and watershed of the project area	Visual inspection, photographic documentation	Annually		
16	Buffer area	In and Around the	Observation and			

NO.	PARAMETER TO BE MONITORED	LOCATION	MEASUREMENT	FREQUENCY	RESPONSIBLE ENTITY FOR IMPLEMENTATION	COST (BIRR) / (USD)
	number of established or upgraded nurseries	project areas and weredas	counting			
17	Buffer area number of seedlings produced	In and Around the project areas and weredas	Observation and counting			
18	Availability of fuel wood, construction wood, and fodder	In and Around the project areas and weredas	Visual inspection			
19	Cultural and Historical sites	In areas where Historical site present and construction site	Supervision works during construction	During construction	EPC contractor, EMU, ARCCH, RBITC	No additional cost
20	Health and Safety	All work places	Observation, inspection and reporting/ Health and safety support	Daily, monthly	EPC Contractor, EMU	Construction
21	Environmental Monitoring Coordination	NA	Monitoring of implementation and success of mitigation measures (including relevant environmental and health/safety plans); Reporting on monitoring results, compliance with relevant legislation, contract and technical requirements	Monitoring continuously Reporting biannually	EPC Contractor	100 000 Birr / 9 366 USD
22	Livelihood improvement	Reservoir	fishery and aquatic resources monitoring	?	?	300 000 Birr / 28 100 USD
1	Reservoir Sedimentation	Gibe and Omo rivers and reservoir	Depth of sediment in the reservoir and sediment concentration in the river	Monthly	MWR	Operation budget
2	Hydrology	River flow (Upstream and downstream of the reservoir) and reservoir level	Inflow, outflow and reservoir level	Daily	MWR	Operation budget
3	Riparian release	Downstream of the reservoir area including lake Turkena	Sampling water quality composition of aquatic flora and fauna	Monthly	EMU	500 000 Birr / 46 832 USD
4	Water Quality	Upstream of the reservoir	Sampling and analysis, Physical, chemical parameters biological	Monthly	EEPCO, EMU	50 000 Birr per year / 4 683 USD per year
5	Water Quality	Downstream of the reservoir	Sampling and analysis, Physical, chemical parameters biological	Monthly	EMU	
6	Wildlife species number and composition	Reservoir, buffer area, relocation road and Buffer area and along river and delta area	Visual inspection and photographic documentation	Monthly for the first 2 yrs and twice a year afterwards	EEPCO	20 000 Birr per year 1 873 USD per year
7	Wildlife hunting and accidents	Reservoir and buffer area and relocation road	Visual inspection, record keeping	Upon incidents	EEMU	
8	Terrestrial Birdlife, reptiles and	Swamps around the reservoir area	Species and habitat inventory at riverine and riparial environments	Monthly for the first 2 yrs and twice a year	EMU	

NO.	PARAMETER TO BE MONITORED	LOCATION	MEASUREMENT	FREQUENCY	RESPONSIBLE ENTITY FOR IMPLEMENTATION	COST (BIRR) / (USD)
	mammals			afterwards		
9	Aquatic Invertebrates	Reservoir and downstream - Omo River and Tributaries and Lake Turkana	Visual survey	Monthly the 1st year, and yearly afterwards	EMU	50 000 Birr per year / 4 683 USD per year
10	Aquatic macrophytes	Reservoir and downstream - Omo River and Tributaries and Lake Turkana	Visual survey	Monthly the 1st year, and yearly afterwards	EMU	
11	Fishery resources Establishment of Baseline Data and successive trends	Reservoir and downstream - Omo River and Tributaries and Lake Turkana	Biological sampling of fisheries (Gillnets and seine nets, catch surveys) and species diversity	Monthly for the first two years and twice yearly afterwards	EMU	
12	Buffer area and areas of woodland restored	Non inundated buffer area and nearby watershed	Observation and record keeping on restored trees and plantation area	Bi annually	EMU	20 000 Birr per year / 1 873 USD per year
13	Terrestrial Riparian Flora	Riverine and riparian environments	Visual inspection, transects	Yearly	EMU	
14	Health and Safety	All work places	Visual inspection and reporting/Health and safety survey	Monthly	EMU	Operation budget
15	Malaria vectors	Seasonal swamps and river delta	Visual survey	Monthly the 1st year, and yearly afterwards	EMU	100 000 Birr per year / 9 366 USD per year
16	Malaria incidence	4 Weredas	Clinics records	Monthly the 1st year, and yearly afterwards		
17	Occurrence of slope failure and landslide	Banks of reservoir and 50 km interval observation points and at selected meanders	Visual inspection - Identify and measure slope failures and landslide prone areas	Yearly	EMU	Operation budget
18	Agriculture: riverbank and floodplains extension and productions; input supply, sale prices	20 km wide strip along river and delta area	Land Cover updating, Wereda records	Yearly	EMU	500 000 Birr per year / 46 830 USD per year
19	Livestock: consistency, localisation, migration, feed sources and health conditions.	4 Weredas	Survey and Wereda records	Yearly	EMU	
20	Changes in food consumption, income, health status, market sales, water uses for agriculture	20 km wide strip along river and delta area	Survey and Wereda records	Yearly	EMU	
21	Environmental Monitoring Coordination		Monitoring of implementation and success of mitigation measures Reporting on monitoring results, and compliance with relevant legislation, contract and technical requirements	Continuous monitoring and biannual reporting	EMU	Operation budget

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