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Republic of Cameroon
République du Cameroun

Lom Pangar Hydroelectric Project

Environmental and social assessment (ESA)



Executive summary

March 2011

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1 BACKGROUND

The Lom Pangar Hydropower Project (LPHP) is a priority project in the Government of Cameroon's development strategy to improve access to reliable low-cost hydropower supply for growth and poverty reduction. As a regulating dam with an associated power house, the LPHP will be a critical step to unlock Cameroon's hydropower potential by improving the guaranteed water flow of the Sanaga River. In the short term, the LPHP will increase the guaranteed production capacity of the two existing hydropower plants on the Sanaga River by at least 120 MW and create an additional 30 MW capacity for rural electrification of the Eastern Region. In the medium term, the LPHP provides access to up to 6,000 MW of hydraulic potential of the Sanaga River by creating the basis for future investments in a cascade of downstream hydropower projects with significant benefits for productivity and growth. Transparent and fair water and electricity pricing mechanisms will be developed to ensure an equitable distribution of project benefits. Capacity building is ongoing to mitigate the project's environmental and social risks and to ensure inclusive communication with all project stakeholders.

The LPHP involves the construction and operation of a series of infrastructure and equipment, notably :

- The dam and its 540 km² reservoir,
- A 30 MW hydropower plant at the foot of the dam,
- A 105 km 90kV power transmission line connecting the plant to the grid,
- The construction and improvement of several access roads, paths and tracks,
- The required adaptation of the Chad-Cameroon pipeline, a section of which will have to operate under water for most of the year.

Lastly, the construction and operation of the Lom Pangar dam will act as a critical facilitating factor in the investment decision for several plants and other infrastructure, thus creating potential cumulative impacts which have been closely studied.

Given its complexity, the LPHP is associated with substantial technical, environmental and reputational risks. The LPHP is located in a remote and environmentally sensitive area in Cameroon's Eastern Region. The LPHP's major risks include (i) the partial flooding of the Chad-Cameroon pipeline (CCP) by the water reservoir at two intercepts of the Pangar river of about 25 km lengths in total requiring an adaptation of the pipeline at these two stretches, (ii) the partial flooding and need for adequate protection of the Deng Deng forest, a natural habitat of large primates, and (iii) the predictable environmental, human and health risks associated with the construction and operation of any large infrastructure in a previously low density area. At the same time, the number of people in need of resettlement is limited, given the present low population density in the area. Extensive public consultation for this long-awaited project has also yielded expectations from local populations which will be partly fulfilled by a rural electrification component funded by the African Development Bank and partly by a set of mitigating local development support measures.

2 THE ESA PROCESS

An environmental and social assessment process is in place to avoid, mitigate and/or compensate those identified potential negative environmental and social. Given the magnitude of the environmental and social work required, the mitigating measures themselves, in some instances, have required their own safeguarding processes (e.g. for the involuntary resettlement linked to the operation of the Deng-Deng National Park). The environmental and social analytical work and recommendations, all designed in a transparent and collaborative manner has been packaged into three sets of documents:

- The ESA documentation consisting of:
 - Volume 1: Environmental and social impact assessment (ESIA) report
 - Volume 2: Environmental and social management plan (ESMP)
 - Their accompanying annexes
- Parallel environmental and social studies: Forest-biomass and cumulative impacts
- The Resettlement actions plans (RAP) for the dam, the transmission line/plant, the access roads and the Deng-Deng resettlements.

Here is a summary of the ESA documentation, as required by OP/BP 4.01 of the World Bank¹.

The ESIA report (volume 1 of the ESA) presents the background against which the LPHP has been prepared and how the project fits into the energy and regional development strategies for Cameroon as well as a summary of the investigation and impact characterization processes that have been conducted over the 2005-2011 period and presents:

- the legal, regulatory and institutional framework along with the sectoral policies applied ,
- the World Bank safeguard policies (SPs) requirements, along with the other donors' commitment to the SPs,
- the analysis of alternatives conducted at various levels (strategic down to technical) for the LPHP in the context of the ESA process, the conclusions of the analysis and the challenges identified for the appropriate implementation of the required safeguard measures,
- the present state of the environment in the project's area of influence ,
- the project description,
- the potential project's impacts and its mitigating measures,
- the public consultation process conducted so far and its documented influence on LPHP's design.

¹ BP 4.01 Article 11: "When the borrower officially submits a Category A or Category B EA report to the Bank, the Region places a copy of the full report in the project file. It also sends the English-language executive summary of a Category A EA report to the Board Operations Division, Corporate Secretariat, under cover of a transmittal memorandum confirming that the executive summary and the full report (a) have been prepared by the borrower and have not been evaluated or endorsed by the Bank, and (b) are subject to change during appraisal."

A set of annexes complements the ESIA report:

- Annex 1: Maps
- Annex 2: Sustainable Fishery Management
- Annex 3: Archeological Resource Management
- Annex 4: Biodiversity compensation implementation: the Deng-Deng National Park
- Annex 5: Public Health Management Plan
- Annex 6: Capacity Building Plan
- Annex 7: Pesticide Management Plan (PMP)
- Annex 8: Construction ESMP
- Annex 9: List of preparers
- Annex 10: References: published and unpublished documentation
- Annex 11: Public consultation records and proceedings

The ESMP report presents, as a complementary approach to the ESIA, the following elements:

- The objectives of the ESMP
- The institutional framework
- The ESMP components and their future implementation
- Analysis of the ESMP implementation
- ESMP implementation schedule and costs.

3 ESIA CONTENT

3.1 Legal, regulatory and institutional framework

The main laws and decrees governing environmental and social management in Cameroon are described hereafter.

3.1.1 National environmental laws and decrees

Law n° 96/12, 5 August 1996 : Environmental Management Framework Law

Stemming from the National environmental management plan (1996), this law sets the general legal framework for Cameroon. It relies on six main principles (precautionary, preventive and corrective action, polluter pays, responsibility, participation and subsidiarity).

Title I Chapter 2 on impact assessment stipulates at article 17 that : « *the promoter or owner of any works that may, due to its dimension, nature or environmental incidences harm the environment, needs to conduct, according to the prescriptions of its terms of reference, an impact assessment evaluating the direct or indirect incidences of the said project on the ecological balance of the implementation area or any other region on the quality of life of local population, and, more generally, on environmental incidences* ».

Article 55 requires from any owner of an industrial or commercial unit (see « loi du 14 juillet 1998 relative aux établissements classés dangereux, insalubres or incommodes ») the preparation of a risk assessment before the opening of the unit, in order to prevent and control potential accidents.

Article 56 prescribes to all owners of any first or second class plant, as defined in the « établissements classés » (gazetted units) the preparation of an emergency plan involving the call for alert among the competent authorities and riparian populations in case of potential or actual industrial accident, staff evacuation and ways and means to control the root causes of the accident.

Two application texts have, in 2005, specified the application modalities of the 1996 framework law:

- Decree n° 2005/577 dated February 23, 2005 setting the EIA preparation and processing modalities,
- Ministry of Environment's (MINEP) order dated March 8, 2005 setting the categories of operations that are subject to EIA.

According to article 2 of Decree n°2005/0577, « the EIA is a systematic analysis aiming at the determination of whether or not a project has a harmful effect on the environment ».

The detailed EIA (applicable to large projects like the LPHP) the EIA should include:

- the description and analysis of the initial state of the site and its physical, biological, socio-economic and human environment,
- the description and analysis of all the elements and natural/sociocultural resources potentially affected by the project, as well as the site selection rationale,
- project description and rationale for its selection among competing activities,

Lom Pangar Hydroelectric Project ; Environmental and social assessment (ESA). Executive summary. March 2001.

- identification and assessment of potential project implementation effects on the natural and human environment,
- indication on the measures proposed to avoid, minimize or eliminate the potential environmental damages,
- a program for awareness building and public information, along with proceedings of the meetings held with populations, NGOs, trade unions, opinion leaders and other organized groups as relevant to the project,
- the EMP, including monitoring mechanisms and, as relevant, the compensation plan,
- the terms of reference of the study, as well as the bibliographical references,
- a summary, in simple language, of the key specific information.

The ESA conducted for the LPHP produced the ESIA, first volume and the ESMP, second volume of the overall process, and provided the content and process aiming at fulfilling the whole of the national laws and decrees referenced here above, and beyond.

[Law n° 2003/003, 21 April 2003 : Law on phytosanitary protection](#)

It stipulates that chemical treatments should be conducted with due respect for the agricultural good practices so that human and animal health and the environment be all protected. Only the certified phytosanitary products and those benefitting from a temporary sale authorization should be used in Cameroon.

[Law n°98/015, 14 July 1998: Law on gazetted and hazardous industrial units](#)

Depending upon the hazards generated and/or the potential nuisances, gazetted units are split into two classes (Article 3). LPHP can be categorized Class 1 for the purpose of this law.

Other legal texts and regulations that have relevance to the LPHP are listed hereafter:

3.1.2 World Bank and other donor safeguard policies (SPs) requirements

World Bank Group (WBG) Strategy. The World Bank is a strategic partner to the GOC in its efforts to improve access to reliable least cost energy supply for growth, employment creation and poverty reduction. Bank's existing energy portfolio with Cameroon includes a \$65 m Energy Sector Development Project, among others providing technical assistance to the LPHP preparations, and a \$20 m Environmental and Social Capacity Building Project for the Energy Sector (PRECESSE). The World Bank is also a donor under the multi-donor Environment and Forestry and Development Program. The Bank has lent \$53.4 m to the GOC to finance its equity stake in the Cameroon Oil Transportation Company S.A. (COTCO) for the Chad-Cameroon pipeline. The World Bank is also preparing an US\$60 m IDA Partial Risk Guarantee to facilitate access to local currency finance for the Kribi gas to power project.

Benefits of World Bank Group engagement in Cameroon's energy sector to date include the mobilization of significant private investment for the realization of least cost sector investments, the establishment of a financing mechanism for rural electrification, capacity building for all sector stakeholders to better execute their mandates and the preparation of the LPHP according to international standards. The proposed project will deepen the World Bank's support to the GOC to ensure that best practice economic, environmental and social standards are adhered to in the realization of the LPHP and that growth and poverty reduction opportunities linked to the project are maximized. This will help GOC establish a credible track

record in the sustainable development of Cameroon's natural resources. The World Bank is working in close collaboration with other donors on the LPHP preparations (e.g. AFD, European Investment Bank, African Development Bank).

Following the Kribi gas to power project, the LPHP has been confirmed as the next least cost investment in Cameroon's electricity sector. In the short term, the LPHP increases the availability and reliability of low-cost hydropower supply for improved competitiveness and poverty reduction. In addition, the LPHP will create a renewable source of electrification of the Eastern Region to connect households which currently do not have access to electricity. In the medium term, the LPHP unlocks access to the hydraulic potential of the Sanaga of almost 6,000 MW, creating significant opportunities for growth and poverty reduction. The realization of the LPHP would create the possibility to cut power costs in half over the medium-term, creating significant opportunities for economic diversification, improved competitiveness and growth and reduced income inequality. The LPHP is a catalyst to realize the mutually reinforcing linkages between sustainable infrastructure investments and growth and poverty reduction. The LPHP is estimated to make a significant contribution to improved productivity, economic growth and poverty reduction. The cost of the investment in the LPHP will be recovered from all beneficiaries through the introduction of a water tariff. To ensure that cost reductions resulting from the LPHP translate into benefits for all electricity customers and to avoid that they do not disproportionately accrue to Alucam, existing cross-subsidies to Alucam will need to be phased out. Respecting best practice standards in setting future electricity tariffs for Alucam is a pre-condition for the World Bank's future support to the LPHP.

An appropriate environmental and social management of the LPHP makes it more attractive to financiers, and thus facilitates its funding under the best possible terms for Cameroon. Integrating environmental and social issues upstream also increases project's profitability by anticipating potential problems and avoiding ex-post mitigating measures, always costlier than prevention. Lastly, the impact of LPHP on economic and social development in Cameroon is also enhanced by a proper management of social and environmental issues and challenges. Beyond the obvious need for complying with national rules and regulations on environmental assessment, the above explains why Cameroon has decided to exert due social and environmental diligence on LPHP according to international good practices, notably World Bank's safeguard policies.

The main other donors concerned (European Investment Bank – EIB -, Agence Française de Développement – AFD - and the African Development Bank – AfDB -) have followed suit and considered that, in the case of LPHP funding, aligning on World Bank's safeguard policies would fulfill their own requirements.

The safeguard policies have been screened to assess which, if any, were triggered by LPHP and here is the outcome of the screening.

3.1.3 Triggered WB safeguard policies

Environmental Assessment (OP/BP 4.01): the project will have significant and irreversible environmental impacts. A draft EA was prepared by Government with AFD support to reduce or mitigate these impacts. Since then, an ESIA and an ESMP has been prepared, following OP/BP 4.01 guidance for a category A project. The draft EA was publicly disclosed in January 2006, and was the subject of public hearings in February 2006. Government requested additional work before the EA could be approved, in a decision by the Minister of Environment from May 2006. An additional study was done in 2007 regarding the location of the workers camp and access patterns to the dam site. The study was reviewed by the World Bank. A critical issue that is being addressed is the flooding by the reservoir of the Chad-Cameroon

pipeline. A management of change is being prepared by IFC and COTCO, including the preparation of an ESAP and an amendment to the Chad Cameroon EMP to ensure that its implementation remains compliant. A cumulative impact assessment has been being conducted on the basis of Terms of References (ToRs) satisfactory to the Bank. A detailed forestry study regarding the recovery of wood in the reservoir and its induced impacts has also being commissioned on the basis of ToRs satisfactory to the Bank, in coordination with AFD. A panel of experts has functioned intermittently since early 2005. It is now supported through the World Bank.

Natural Habitats (OP/BP 4.04). The project will have significant impacts on natural habitats, both during construction and operation of the dam. The main impact will be the flooding of about 540 km², including approximately 300 km² of natural forest. The EA indicates that none of the flooded terrestrial habitat is critical as defined in OP/BP 4.04. However, the dam site is located next to portions of the Deng Deng Forest that are critical habitats, particularly because of the presence of a viable population of gorillas, and a significant population of chimpanzees. The environmental significance of the Deng Deng forest was identified in the context of the Chad Cameroon Pipeline Project and led to its realignment, and was also discussed with Government in the context of the Forestry and Environment Project. The no project alternative is a gradual degradation of the Deng Deng forest that could lead to the extinction of its gorilla population. In the context of LPHP, Government commissioned additional work by WCS on the Deng Deng gorillas in late 2008, including immediate protection measures, and leading to the establishment of the National Park before construction of the dam starts, which occurred in January 2010.

Forests (OP/BP 4.36) Forest issues include recovery of the wood from the future reservoir, as well as control of induced impacts at the periphery of the reservoir. A supplemental study has been commissioned on the basis of ToRs satisfactory to the Bank, to ensure that recovery of the wood follows World Bank guidelines, including benefit-sharing with local population, and to limit induced impacts. The study will also ensure that most of the biomass is removed to reduce greenhouse gases, particularly methane emissions after flooding.

Pest Management (OP 4.09): given the limited, but potentially harmful, quantities of pesticides and other biocide products utilized for three major categories of works related to the LPHP: construction/tree removal works, support to agricultural development and public health management (as a mitigating measure), it was decided in the course of ESA preparation, to prepare a Pesticide Management Plan (PMP) which is attached to the ESIA report.

Physical Cultural Resources (OP/BP 4.11) Physical Cultural Resources were covered in the draft EA from 2005. Further work was in application of World Bank policies for the future flooded area as well as for the major linear infrastructure works. The need for capacity enhancement in the Ministry of Culture was identified and appropriate action recommended. Processes for building capacity in construction teams as well as to ensure appropriate conservation of archeological artifacts and its chance finds during construction and maintenance of the main infrastructure works were built into a discrete sub-component of the EMP.

Involuntary Resettlement (OP/BP 4.12) The LPHP is expected to have direct and indirect social impacts in its area of influence and beyond. Consistent with WBG safeguards policies, OP/BP 4.12 was triggered and social mitigation plans identified. Resettlement action plans by broad categories of works (dam and reservoir, power plant and transmission line, access roads) were prepared as well as a process framework for the Deng Deng national park to mitigate,

offset, reduce negative impacts and strengthen positive impacts on the communities in the Project area. The resettlement recommendations are packaged in a separate set of RAPs.

Safety of Dams (OP/BP 4.37) EDC has appointed an independent dam safety panel during project preparation. An instrumentation plan is being elaborated as part of the revised engineering design. A construction supervision and quality assurance plan, including a provision for the continuation of a dam safety panel, and a draft operating and maintenance plan were reviewed by the dam safety panel and submitted to the World Bank before the authorization to appraise the LPHP. A Dam Safety Plan was prepared and, as practiced in World Bank funded projects, will not be released for public disclosure.

3.1.4 World Bank safeguard policies that are not triggered

Indigenous Peoples (OP/BP 4.10)

No Pygmies and other indigenous peoples according to OP 4.10 have been found in the project area. The case of the Mbororos, present in the project area, mostly through herding activities, was analyzed and discussed and targeted measures were built into the RAPs.

Neither **Projects on International Waterways (OP/BP 7.50)** nor **Projects in Disputed Areas (OP/BP 7.60)** are triggered.

3.1.5 The World Bank's Inspection Panel

Though this does not constitute World Bank policy, the existence and operation of the World Bank's Inspection Panel has clearly influenced practice and Panel's rulings have been used as lessons learned for the design of the present ESA.

In particular, the Inspection Panel has been called upon to process two complaints from civil society on the Chad-Cameroon Pipeline Project and its associated capacity building project (CAPECE).

In the two instances, the Panel has found much compliance with World Bank policies, but has also ruled that the World Bank had violated its OP/BP 4.01 EA policy by i) overlooking the need for a Regional Environmental Assessment (REA) and ii) not being effective enough in helping the Government of Cameroon implement the capacity building project.

While the overwhelming majority of Inspection Panel cases are for projects under implementation, it is clearly in the interest of EDC, the GoC and donors to ensure maximum policy compliance at the present design stage.

3.1.6 The processing needed to ensure safeguard policy compliance

Safeguard policy compliance is a requirement for authorizing project appraisal, a key step in World Bank project processing. Based on its own internal review of the environmental and social assessment, the World Bank will decide whether or not to appraise the LPHP. Once the decision is made, all environmental and social documentation needs to be disclosed, in-country and on the WB's external Web site, and a summary in English needs to be sent to the Board of Directors. Board presentation of the project is generally at least four months after decision to appraise, a delay that also fulfills the requirements of the US so-called Pelosi amendment. Should the environmental and social documentation not be deemed acceptable to the Bank, Bank's comments on the compliance check need to be incorporated before a new appraisal decision process is started.

3.1.7 World Bank safeguard policies and national requirements

Commonalities and differences between the requirements of the seven triggered safeguard policies (SPs) and national laws and decrees were identified and several SPs requirements that are beyond Cameroonian expectations, in particular for large and complex projects like LPHP, were identified:

Environmental Assessment

- Integration of indirect, induced and cumulative impacts, as applicable
- Recommendations for regional or sectoral environmental assessment (EA) if and where needed
- Analysis of the legal and institutional framework
- Analysis of investment feasibility and systematic comparison of the « with » and « without » project scenarios
- Need for independent expertise for EA preparation and utilization of an advisory panel during project/EA preparation and implementation,
- Referencing the Pollution Prevention and Control Handbook.

Physical Cultural Resources (PCRs)²

- Analyze project alternatives
- Whenever feasible, avoid funding projects that are potentially harming PCRs
- Consult local populations
- Include chance find clauses
- Define and propose ad hoc capacity building measures
- Disclose PCR mitigation plans (as part of the EA report) in draft before appraisal mission and apply transparent disclosure conditions.

Natural Habitats³ (NH)

- Apply the precautionary principle. Weight project costs and benefits in terms of NH
- Ban damage to critical natural habitats
- In case of damages to non critical natural habitats, review all feasible alternatives and protection mechanisms. If applicable, compensate with enhanced protection of similar ecological areas
- Where feasible, locate projects on already converted lands
- Consult the main stakeholders and involve them in the design, implementation and monitoring activities

² Since there is no equivalent Cameroonian policy, it was considered that all the prescriptions of OP/BP 4.11 were beyond national requirements.

³ Same as PCR policy

- Ensure appropriate technical and scientific expertise
- Disclose mitigation plans (as part of the EA report) in draft before appraisal mission and apply transparent disclosure conditions.

Pest Management (PM)

- Minimize the utilization of pest management products and train users as required
- Draft and implement Pest Management Plans (PMPs)
- Consult the main stakeholders and involve them in the design, implementation and monitoring activities
- Ensure appropriate technical and scientific expertise
- Disclose mitigation plans (as part of the EA report) in draft before appraisal mission and apply transparent disclosure conditions.

Dam Safety⁴

- Prepare a Dam Safety Plan
- Conduct work supervision and implement appropriate measuring equipment
- Put in place and maintain an early warning system
- Intervene fast and strongly in case of dam failure.

3.1.8 Proposed institutional framework for ESMP implementation

LPHP's environmental and social activities have been designed in a complex context, where challenges are numerous and opportunities multiple. These activities are monitored and evaluated at several levels by the various stakeholders according to the following design:

EDC is LPHP's implementing agency, under the umbrella of both Ministry of Energy and Water (MINEE) and Ministry of Finance. The project receives close attention from the Cameroonian Presidency.

- A technical advisor to the Director General of EDC is dedicated to environmental and social matters.
- The Project Director, placed under the authority of the Director General has overall responsibility for the design and implementation of all financial, technical, environmental and social issues related to the Lom Pangar dam and its associated infrastructure.
- The **Sub-directorate Safety Environment and Regional Development**, under the Project Director, ensures day-to-day the steering and the monitoring of all environmental and social aspects of LPHP, notably the organization of environmental studies, monitoring of the environmental aspects of the construction works, the management of compensation and resettlement-linked aspects, and ESMP implementation.

⁴ Same as PCR policy

The project also involves the activities of several **ministries** - beyond MINEE - at the central level, notably MINEP, MinFOF, the Ministry of Social Affairs, the Ministry of Economics and Regional Planning (MINEPAT), and the Public Works Ministry for the construction of the access roads. EDC coordinates closely with those Ministries, either in a bilateral mode, or through interministerial coordination.

At the field level, notably for the implementation of the local development support activities, GoC's activities will be coordinated in the framework of a **Steering Committee** already created: the « Comité de Suivi, de Facilitation et d'Accompagnement » (CSFA, Accompaniment, Facilitation and Monitoring Committee) placed under the leadership of the Eastern Region Governor with EDC as of jure vice-president, logistics provider and coordinator.

Independent Environmental and Social Panel: The panel, made up of experts with recognized international experience in ESA, is an independent entity set up by EDC in agreement with GoC and donors to provide advice and recommendations on all environmental and social aspects of LPHP

Dam engineer: Just recently signed in, the Coyne and Bellier/ISL group has as overall mission to ensure control and supervision of the construction works for LPHP.

On environmental and social aspects, the engineer must:

- Check the compliance of the PTSs and of work methods designed and prepared by the work contractors consistent with the « Construction ESMP » as required in the call for bids by EDC,
- Check and control the implementation of the said PTSs,
- Lastly, for all the associated infrastructure works,: (a) provide EDC with the technical assistance required to guarantee compliance with the environmental and social standards defined in the « Construction ESMP »; (b) provide the engineering services for the construction of the bridge and of the second phase of EDC's workers camp.

COTCO has a specific role to play in constructing the pipeline adaptation ahead of the reservoir flooding. In doing so, COTCO complies with its own IFC/World Bank requirements and cooperates with EDC under the conditions of an Interface Agreement (IA) being finalized as of February 2011.

3.2 Analysis of alternatives

OP/BP 4.01 mandates the inclusion of an analysis of alternatives within the EA process⁵. On several occasions, the World Bank's Inspection Panel has identified weak analyses of alternatives as a violation of Bank's safeguard policies.

Lom Pangar has been subject to a series of analyses of alternatives, some of which were directly incorporated into project design. It underlines the process aspect of Environmental and

⁵ « EA for a Category A project examines the project's potential negative and positive environmental impacts, **compares them with those of feasible alternatives (including the "without project" situation)** [emphasis added], and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. »

Social Assessments. Other alternatives were analyzed in the context of the implementation options.

Hereafter is the presentation of the analysis of alternatives, starting from the power demand projection, which provides the overwhelming justification for the power supply increase, for which Lom Pangar is the least cost solution .

3.2.1 Power demand analysis

Three reference scenarios have been defined in the ESDP 2030; they are based on the economic growth assumptions of the Growth and employment strategy paper (GESp) designed by GoC and revised in 2005. Lom Pangar project's justification and reservoir capacity optimization have been analyzed in the framework of the « Low » (1,430 MW demand forecast by 2020) and « Median » (1,680 MW by 2020), scenarios, the « Huge ambitions » scenario (3,839 MW at horizon 2020!) justifying in any event all feasible power production investments.

3.2.2 Power supply options

Two main supply options are a priori competing for medium to term power production in Cameroon: hydropower and thermal from natural gas. The studies conducted in the context of the analysis of alternatives for Lom Pangar support the choice of the hydropower option to increase power supply on the interconnected South network, from the point of view of economics as well as of the global environment.

As far as hydropower, two options are feasible and complementary: storage enhancement and new dams. As far as storage enhancement, Lom Pangar's competitors are Bankim, Mbakaou and Litala, and Lom Pangar has two decisive advantages (lowest per stored m³ cost and the only solution with a reservoir larger than 3.3 km³ in capacity). The only new dam rivaling with the Lom Pangar/Nightingal complex is the Bankim-Nyanzom complex, but the latter offers a cost superior to Lom Pangar's by 15% and also suffers from preparation deficiency.

3.2.3 Lom Pangar's selection justification

Site selection

Project's location on the Sanaga is justified from the viewpoint of a strong hydropower potential in the watershed (over 50 % of Cameroon's potential) and the location within the watershed of the main demand centers, including both economic and political capital cities.

Macro-economic justification

Lom Pangar's reservoir's objective is to enhance Sanaga's low flows in order to saturate the production capacities of Song Loulou plant.

As of now, the existing works allow a low flow of about 600 m³/s at Song Loulou and Edea. With a Lom Pangar reservoir at 6 000 hm³ of useful capacity, a flow control at 950 m³/s guaranteed 90 %, of the time, is feasible, i.e. a 350 m³/s addition to the managed flow.

At the retained 6 000 hm³ useful storage capacity, Lom Pangar's impact on Song Loulou and Edea is an increased 223 GWh/year.

Additional power production allowed by Lom Pangar (6 000 hm³)

Song Loulou and Edea	223 GWh/year
Song Loulou and Edea + Nachtigal	675 GWh/year
Song Loulou and Edea + Nachtigal and Song Dong	775 GWh/year

Project cost

It has been estimated at 71.5 billion CFAF (109 millions €) under the economic conditions of October 2009 according to the Detailed Design dated April 2010.

That cost includes the civil works and the water intake for the local hydropower plant. Excluded from that cost estimate are the plant itself, the transmission line, the costs of implementing the ESMP, the RAPs and the Chad-Cameroon pipeline adaptation.

The Present net **benefit (2010)** with a 10 % rate is, for the « Lom Pangar-Nachtigal » complex, **414 billion CFAF** (at the 2005 economic conditions), showing the interest of the hydropower option with an IRR above **25 %** (uniquely based on Lom Pangar's CAPEX).

Environmental assessment

The GHG net emissions from the Lom Pangar reservoir are estimated to 21 million ton-equivalent of CO₂ over 100 years, but the LPHP saves about 140 million tons of GHG over the same period. The balance is thus clearly in favor of Lom Pangar, especially considering that its construction opens the door to a larger resource mobilization scheme on the Sanaga.

The following table summarizes the unweighted comparison (rating from R--(redhibitory) to A++ (acceptable)) of the various alternatives comparing their potential impacts with natural gas's:

Environmental comparison of alternatives to Lom Pangar

Criteria	Natural Gas	Lom Pangar	Bankim Nyanzom
Involuntary resettlement risk	A	A	R--
impacts on other local populations	A	A++	A+
impacts on economic activities	A	A++	A+
impact on health	A	R-	R-
impact on the natural environment	A	R-	R-
Potential to electrify neighboring villages	A	A++	A++
Benefits stemming from the access roads	A	A++	A+
Water quality degradation	A	R-	R-
interaction with the Chad/Cameroon pipeline	A	R-	A

Impact is rated on a scale from R⁻ (redhibitory) to A++ (acceptable)

Lom Pangar is the best choice for Cameroon:

- Hydropower is the least-cost option,

- Within that option, Lom Pangar is the strategic response providing a short and long term solution by optimizing the existing facilities with a least-cost site and the opening up of other dam works (Nachtigal),
- The environmental and social impacts of the project, including its ancillary infrastructure are manageable.

3.2.4 Analyzing LPHP implementation options

The analysis of alternatives went beyond the simple comparison among macro power generation or dam location options. The analysis also included a hard look at the following options for the concrete implementation of LPHP:

- Dam design
- Optimizing reservoir's capacity
- Alternative access to the site
- Construction, quarry and material extraction facilities
- Clearing of reservoir's wood resources before flooding
- Belabo-Deng Deng road route selection
- Power transmission line routing

3.2.4.1 Dam design options

Spillway

The basic design is based on a gated spillway. In response to a demand by the Independent Expert Panel, that spillway has been complemented by an additional discharge capacity, equipped with a fuse gate. Furthermore, the reservoirs design now incorporates an additional volume of 1 billion m³ to store part of the extreme flood hydrograph, significantly improving the hydrological safety of the dam.

Optimization of reservoir's capacity

It was conducted from the triple point of view of: hydrology/hydraulics, economics and environmental/social

The simulations show that going from 5 km³ to 7 km³ in capacity leads to an increase of 5 a 10 % of the firm discharge guaranteed 90 % of the time during low flows. Going from 6 to 7 km³ only increases the discharge by 1 to 2 %. The hydrological efficiency is this significantly increased between 5 and 6 km³, but only marginally between 6 and 7 km³. Having a 7 km³ reservoir does not provide the nation with a guarantee that shortage will not occur in case of two consecutive dry years.

With a final capacity design of 6 km³, the impact of drawdown at the tail of the reservoir exists, but in a limited manner, since the tail is located at the level of Mbamjock/Tapare Salao and since the number of inhabitants directly affected is low.

At the end of this analysis, EDC has settled for a useful **capacity of 6 billion m³**, corresponding to a normal reservoir elevation of 672.70 m. At that elevation, reservoir area is 540 km².

Access to the site

A comparative analysis of the various site access possibilities was conducted in the context of the 2005 EIA. That analysis was complemented, in 2006, by donor request, in particular to take more into account the possibility of a railway delivery to the construction camp from the right bank of the Lom. Two broad options, complemented by sub-options, were analyzed: left bank access via Deng Deng and right bank access via the bridge on the Lom.

At the end of a multi-criteria analysis (environment, socio-economics, cultural and technical, financial), the left bank road access was selected; Its strong and weak points can be summarized as follows:

Strengths

- minimizes project cost
- allows the initial dam construction schedule to be implemented
- has a good social acceptability
- presents significant advantages in terms of territorial development
- is compatible with pipeline EMP.

Weaknesses

- increases the risks on large primates populations and thus induces a reputational risk for Cameroon in case these populations die out
- requires the implementation of biodiversity conservation mitigating measures

Construction camp area, quarries, material extraction sites

Original designs recommended the implementation of all construction camp areas on the left bank of the Lom. A complementary study, undertaken by the consultant in 2007 concluded that the optimal location of temporary construction camps was on the right bank of temporary. However, for operational and safety reasons, it was decided to establish the permanent EDC facilities on the left bank, some 1.5 km away from the dam, in an area bordering the access road.

Quarries and other material extraction areas

The Kouma dome, originally identified as potential quarry site, turns out to be extremely sensitive given its location in the heart of the primate-rich Deng Deng forest. Implementing that quarry inside the dome area had been identified as a major potential impact of the LPHP, and the search for a suitable alternative site had been recommended. The new location is now the Mbi Bawara quarry located on the right bank of the Lom. Similarly, the latest project designs are based on the operation of lateritic material areas PEG B and PEG D located on the left bank of the Lom, below the normal reservoir elevation.

Alternative solutions for reservoir's partial clearing before flooding

Several clearing options were identified and systematically compared, including totally clearing of the area meant to be flooded.

In the most recent (February 2011) study conducted by Pöyry/ONFI, a technico-economic breakdown of actions allowing a partial clearing and a multicriteria analysis were conducted, leading to recommendations that were presented to EDC and the potential donors for approval. Hereafter are the proposed actions.

Wood extraction and clearing actions recommended

Measure	Recommendation
Commercial timber extraction	Strongly recommended
Industrial wood extraction	Recommended, but, because of uncertainty about industrialists' interest, an international call for bids should be conducted to test the interest.
Fuel wood extraction	Non recommended, too expensive
Biomass extraction for local non industrial usage	To be authorized among populations wishing to harvest biomass, but with the caveat that the said populations should not become irreversibly dependent on forest products.
Residual unvalued biomass combustion	Partial combustion Recommended in the permanent flooded area
Fill & flush reservoir filling	An anticipated partial reservoir filling is recommended. A fill & flush filling would have a too negative impact on public power demand.
Use of gates facilitating gas removal	Recommended; will be implemented as a flip bucket with or without chute block. Technical design being finalized.
Compensation of GHG emission via the creation of a carbon sink.	Not recommended, too expensive

Alternative routing for the Belabo-Deng Deng road

Transport by rail of the equipment and goods required for dam construction is the recommended option. It implies a downloading/reloading at Belabo followed by hauling to Deng Deng, which in turn requires road improvement on that route. The main works include: clearing of wooded areas along the axis, financial compensation and resettlement of populations living presently on the 40 meter right-of-way building a platform 15 m wide, road drainage.

Several alternative itineraries have been analyzed and compared for the Belabo Deng Deng route. On the basis of a multi-criteria analysis, Belabo - Satando - Mansa Crossing- Deng Deng has been selected. The criteria used can be regrouped in four main themes:

- Implementation and organization (functionality (services rendered) / reliability (sensitivity to climate hazards and traffic interruption risks on technical grounds), organizational feasibility schedule and on dam construction schedule, cost (investment/operation/maintenance))
- Socio-economic aspects (potential for area unlocking, effects on economic activities, effects on household income, local social acceptability)
- Environmental aspects (physical support (soils, water, air), natural habitats (habitat destruction, etc.), accessibility to sensitive ecosystems (habitat fragmentation, access opening, etc.), ecological connectivity to UTO Lom Pangar)
- Policy, legal and consistency with other projects aspects (legal compatibility, consistency with ongoing or planned developments and equipments, effects on land tenure situation related to socio-economic and ecological challenges).

Alternative routing options for the transmission line

Given the relatively large number of possible options, the study has been done in two phases:

- A northern section linking the dam site to Goyoum or Deng Deng (three alternative routes),

Lom Pangar Hydroelectric Project ; Environmental and social assessment (ESA). Executive summary. March 2001.

- A southern section linking Goyoum or Deng Deng to Bertoua (four alternative routes).

The final selection was the following:

- In the north: « N3 » going directly from the dam site, bordering the DDNP down to Deng Deng,
- In the south: « S4 » linking Deng Deng to Bertoua along D30.

That overall route is the only one showing an estimated cost under 10 billion CFAF; its maintenance costs are higher than the competing routes: however, the recommended route suits the environmental and social criteria better.

Synthesis

At the end of a long maturing process, it appears that the preparation of the LPHP allowed for a fruitful synergy between environmental and technical studies. :

- Optimization of reservoir capacity bringing it down to 7 from 6 billion m³, thus allowing a reduction by 1,80 m of the normal reservoir elevation, the preservation of fifty-some km² of land at the tail end of the Lom wing of the reservoir and a reduction of the impacts on local populations,
- Optimization of the access to site during construction and operation,
- Improvement of the location of temporary construction camps, quarries and other material extraction areas, thus limiting the pressure on the most sensitive environment,
- Risk reduction, especially vis-a-vis rare high flows, through the provision of an additional discharge capacity and additional storage volume of 1 billion m³.

The main sustainable development challenges in the influence area of LPHP

Beyond the mechanical application of the safeguard policies triggered by LPHP, the borrower wishes to use the project as an opportunity to implement a sustainable development approach in Lom Pangar.

In order to help implement this complex approach, three main challenges were identified, which inspired the ESMP design:

- Make the dam construction and reservoir management exemplary in terms of the maximization of net environmental, social and economic benefits
- Manage sustainably the UTO and its biodiversity
- Protect and improve the local living conditions, including for resettled people

These challenges are described in more detail in the main body of the ESIA report and constitute the three substantive components of the ESMP, described in volume 2 of the ESA.

3.3 Project description

3.3.1 Funding for the project

The World Bank presents the LPHP as follows: preliminary project costs are estimated at USD 430 m, of which USD 175 m for the dam, USD 45 m for the power house, USD 22 m for the transmission line, USD 60 m for the adaptation of the Chad-Cameroon pipeline, including

preparatory studies, USD 5 m for the access road, USD 100 m for the ESMP, USD 15 m for a communal development program and USD 10 m for technical assistance. The project will be developed by Lom Pangar SA, a subsidiary of EDC to be structured as a Special Purpose Vehicle (SPV). The access road and cost of the adaptation works for the Chad-Cameroon pipeline will be financed by the GOC and preparatory studies and works for the pipeline adaptation will be carried out by COTCO. The proposed IDA credit will co-finance the construction of the dam, the power house and the ESMP, will finance a communal development program and will provide technical assistance to project construction and supervision. IDA will provide a total of \$75-100 m in co-financing.⁶ The transmission line is expected to be financed by the African Development Bank (AfDB) and Central African Development Bank (BDEAC).

Source	(\$m.)
BORROWER/RECIPIENT	65
International Development Association (IDA)**	75-100
Agence Française de Développement (AFD)	75-90
African Development Bank	95
European Investment Bank	45-75
BDEAC	20
Other Bilaterals	22
	430

3.3.2 Role of the ESA

World Bank's OP 4.01 defines EA as a « *process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The Bank favors preventive measures over mitigatory or compensatory measures, whenever feasible* »

The social dimension added after the latest major revision of the 4.01 policies, does not prevent the ESA from equally being a continuous process, including, but not limiting itself to, the initial analytical phase leading to the publication of reports. ESA continues throughout the project cycle, a fact that is abundantly confirmed by the evidence of the quasi-entirety of complaints accepted by WB's Board through its Inspection Panel.

3.3.3 Physical description

The Lom Pangar dam project is located in Eastern Region of Cameroon, Lom and Djerem « département ». Its infrastructure is made up of:

- a 45 m high dam known as Lom Pangar and a reservoir covering a 540 km² area,
- the Touraké bridge,
- a hydropower plant with a 30 MW capacity,

⁶ IDA amounts are indicative and will be updated following the revision of project costs and the availability of IDA financing which depends on the exchange rate for Special Drawing Rights (SDR).

- of an interface between the reservoir and the Chad-Cameroon pipeline, a section of which will be under water after the filling of the reservoir,
- of an ensemble of access roads and tracks built or improved for the purpose of the dam construction and/or maintenance of rehabilitation,
- of a transmission line or 90 kV linking the power plant and the interconnected network at Bertoua over a distance of about 105 km,
- Buildings and equipment required to implement the recommendations of the present ESA taking the shape of resettlement of displaced populations and surveillance and management infrastructure inside the Deng-Deng UTO.

The Lom and the Pangar drain the Eastern part of Sanaga watershed. The watershed area of the Lom at the dam site is 19,700 km². That of the Sanaga at ocean outlet is 134,170 km². The course of Sanaga is regulated by the three dams of Mbakaou in Adamaoua, Bamendjin and Mape in the Western and Central regions. The Lom is the only large contributor to the Sanaga not to be presently regulated by a dam.

The Lom Pangar site is to be found on river Lom, about 4 km downstream of its confluence with the Pangar, 13 km upstream of its confluence with the Sanaga⁷, and 120 km north of Bertoua, where the Eastern region is headquartered.

The geographical coordinates of the future dam, according to WGS 1984 UTM 33N projection, are:

- Latitude North: 334053.209
- Longitude East: 595236.878

Access to the site is from the Lom left bank from Deng-Deng, using a 27 km road. Access to Deng Deng can be via:

- Road from Bertoua by using a surfaced dirt road about 90 km long. Bertoua is linked to Yaoundé (350 km away) using the tarred N10 road,
- Train from Yaoundé to Belabo or Goyoum stations on the TransCameroon on its way to Ngaoundere. From Belabo or Goyoum, it's dirt roads all the way to Deng Deng.

The transmission line, with a total length of 105 km, is meant to transmit the power produced by the hydro plant to the network hub in Bertoua.

It is made up of two sections:

- Northern section: starts from the 90 kV transformer of the hydropower plant, goes straight south crossing DDNP on the east down to Ouami. That route is consistent with the overall project since it partially utilizes the dam access,
- Southern section: starts from Ouami, links to Deng Deng along the dirt road, then to Bertoua following D30.

3.3.3.1 Area of influence

The main area of influence for the dam is located in the Eastern Region, in the Lom and Djerem « département ». It extends to a part of Betare Oya and Belabo « arrondissements » areas. The

⁷ Drawing a straight line.

immediate area of influence includes (i) the area inside which project's direct, indirect and induced impacts are felt, an area that can be mentally represented as the area around the main infrastructure elements required by the LPHP, as well as (ii) a much larger area inside which the cumulative are felt, impacts whose responsibilities will be shared between EDC and the relevant developers.

That area of influence possesses « a variable geometry », as shown in the following table, on account of the nature of the impacts and of the sequence works -> impacts.

Spatial influence vs. environmental components

Environmental component		Project's influence area			
		Local	Regional	National	Global
Physical environment	Air	Pollution/nuisance			GH effect
	Water quality	Surface and underground waters			
	Hydrology	Sanaga's regime			
	Soils	Land use			
	Risks	Dam failure			
Biological	Terrestrial ecosystem	Terrestrial biodiversity			
	Aquatic ecosystem	Aquatic biodiversity			
Human environment	Economic activities	Fisheries, agriculture, livestock, artisanal gold mining			
	Local communities	Communities previously living in the reservoir area or still living around it and in the UTO			
	Cultural heritage	Cultural goods Archeological heritage			
	Structuring equipments	Hydro electrical opportunities development			
Hydro electrical plant					

Environmental component		Project's influence area			
		Local	Regional	National	Global
		Rural electrification, transmission line			
		Chad-Cameroon pipeline			

A 20 year duration has been used as the period for observation, impact minimization and mitigating/monitoring measures' design and implementation. However, out of a concern for exhaustiveness, a couple of pointers, such as the potential impacts of dam removal, have been presented.

The main infrastructural element of LPHP is the dam itself. Its principal function is to store water during the rainy season and release it during the dry season. In order to get the dam built and optimize its operations, as strategically required by Cameroon, several key steps are mandatory, including the first two (detailed design and launching of the call for bids) have, in themselves, no direct environmental impact. The camp construction phase, has, on the contrary potential negative impacts on the environment and on local populations, impacts that the present ESA tries to minimize.

3.3.3.2 BR3 Construction camp construction

The construction camp is made up of six large units (main gate, police bureau, EDC platform, contractor's platform, water system, generators and miscellaneous networks).

The lodging area for EDC includes one sub-area for workers and one for white collars. Workers lodging are made up of 6 identical blocks, each including 2 sitting rooms, eight bedrooms, one kitchen and four toilets. White collar lodging is made up of 6 identical blocks, each including 2 sitting rooms, 2 bedrooms, 2 walking closets, one kitchen and two toilets.

Contractor's construction camp is much larger than EDC's and its potential environmental impacts are much more severe. EDC camp construction, performed in 2010, has unfortunately been done in a below standard, non compliant, application of the specific terms that had been agreed upon between EDC and donors, terms that were supposed to be respected by the contractor.

3.3.3.3 BR4 Dam construction

The dam is made up of two parts: the median part that integrates all hydraulic works, is a gravity dam made out of roller compacted concrete (RCC) while the wings of the dam are laterite-fill embankments with clay core. The dam is complemented with a saddle embankment closing a topographical depression on dam's right bank.

The construction du dam requires a large quantity of materials, main ones being listed here after.

Material needs for dam construction

Item	Unit	Total quantities
Excavations		
Topsoil removal	ha	204
Loose soil excavation	m ³	752 900
Rocky soil excavation	m ³	44 140
Fill		
Rockfill from excavation	m ³	24 600
Rockfill from quarry	m ³	760 000
Lateritic soil (borrow)	m ³	687 800
Lateritic soil (excavation with backfill)	m ³	410 200
Clay kernel	m ³	281 000
Filter, drain and transition	m ³	117 800
Rip-Rap	m ³	31 500
Sealing coat	m	8 000
Downstream protection	m ³	41 400
Concrete, casings, steel		
RCC	m ³	185 150
Grout enriched RCC	m ³	7 005
Mortar	m ²	58 730
Upstream face	m ²	5 230
Downstream face	m ²	3 730
Unit designation		
Plain concrete		0
First phase CVC (Conventional Vibrated Concrete)	m ³	82 520
Second phase CVC	m ³	9 510
Steel	kg	4 296 000
Traditional formwork	m ²	52 560
Special formwork	m ²	5 460
Injection		
Deep grout cut off	ml	2 500
Consolidation grouting	ml	5 510
Drainage curtain	ml	960
Soil grout curtain	m ²	5 000

3.3.3.4 BR5 Clearing/logging ahead of reservoir flooding

A feasibility study was conducted on the details of logging 31,643 ha of forests to be found on 12 plots of land. The 1.4 million m³ of timber of what the clearing/logging would yield would cost about 48.6 billion CFAF (including 2.8 of communal taxes) and represent an exportation value superior to 62.9 billion CFAF for the most valuable species (Ayous, Bete, Doussie Frake, Fromager, Iroko, Landa, Lotofa, Tali and Dabema). That commercial logging would be complemented with artisanal logging conducted by representatives from the local populations.

The clearing and logging works will require the rehabilitation of nearly 300 km of access roads on the sections Mararaba-Meiganga, Mararaba-Betare Oya and Deng Deng-Bertoua.

3.3.3.5 BR6 Touraké bridge construction

The optimal mode for crossing river Lom at Touraké was selected as the construction of a bridge replacing the ferry used presently. Two options, still under consideration, have been proposed:

- Two lane bridge with two sidewalks allowing pedestrians, one of the lanes being reserved to cattle during the seasonal migration period,
- One lane bridge with two sidewalks allowing pedestrians and two 10 m x 30 m parking areas allowing vehicles to wait for the full passage of another one.

The bridge has been designed for a 50 ton load (maximum load authorized in Cameroon) allowing log-transportation trucks on it. The bridge is 105 m long in three sections (two side sections 30 m long and a central one 45 m long) and has a mixed steel/concrete structure.

3.3.3.6 BR8 Dam/reservoir operation

For environmental and social reasons, it was proposed and accepted by EDC, that the reservoir would be filled in a stepwise manner to allow fauna to leave the flooded areas and settle outside the reservoir area. The filling out operation will expand over 3 years. Water level rise will be about 90 cm per month.

Dam operation takes into account the water level in the reservoir as well as in the other reservoirs in the watershed, the planned inflows and the demand forecast. Water management in the reservoir will be optimized while respecting the constraints imposed on the developer by the miscellaneous uses of the river. Dam and reservoir management are determined by a water management plan to be designed and approved by EDC.

Many a potential impact of LPHP is determined by the way in which the reservoir will be managed and there will be the absolute need to incorporate a strong environmental and social section in the Manuel reservoir management handbook as well as to ensure appropriate specific training to the reservoir managers (see ESMP).

3.3.3.7 BR9 Dam removal

Life duration for the likes of Lom Pangar works will span over 60 to 100 years. Over such a long period, it is hard to predict how the works will evolve. Furthermore, experience worldwide with dam removal is limited. At the time when Lom Pangar dam removal will be required, the developer/manager will need to answer the key question: should all forms and shapes of the works be simply wiped out or should the structure simply be rendered safe? Whatever the answer to the question is, an ESA of the removal will need to be conducted and applied.

3.3.3.8 UP1 Hydropower plant construction

The local future hydropower plant will deliver a 30 MW power generated by 4 Francis turbine groups, and aims to fulfill the growing power demand of the Eastern region. The Plant's design is conventional and, provided its construction follows the ESMP, is not likely to generate unmanageable environmental impacts.

3.3.3.9 UP2 Hydropower plant operation

It has been designed to ensure base power generation, using the downstream guaranteed flow of 90 m³/s, as well as function during peak demand times according to the needs of the

interconnected network. For a reservoir capacity of 6 billion m³, the yearly production is expected to be 92, 5 GWh with the two initial turbines, then 185 GWh at full regime once the 4 turbines installed.

3.3.3.10 LT1 Transmission line construction

Its role is to carry the electricity generated by the hydropower plant all the way to the Bertoua facility. The line is made up of two sections:

- Northern: starting from the 90 kV transformer at the plant, the line goes straight south crossing a part of the DDNP down to Ouami, carrying on the Deng Deng. That route is consistent with the LPHP since it partially follows the access to the dam,
- Southern: starting from Deng Deng, the line reaches Bertoua by following D30.

3.3.3.11 LT2 Transmission line operation

Transmission line operation requires periodic maintenance that, in turn, generates access opportunities which call for strong anti-poaching and anti-illegal logging surveillance.

3.3.3.12 VA1 Access road construction/rehabilitation

Cameroon, via EDC and MINTP, has committed to rehabilitate access roads to the dam site du dam before LPHP effectiveness.

It concerns mainly the following roads:

- Bertoua-Deng Deng : 90 Km. The works are within the framework of the routine maintenance for the road, already a responsibility of MINTP,
- Goyoum – Lom Pangar: 42 km, already performed by MINTP back in 2009. However, it is only the Deng Deng- Lom Pangar section that is destined to be used as access road to the site during the construction and operation phases,
- Belabo-Satando-Mansa-Deng Deng (57 km) needs widening.

The works on the Bertoua-Deng Deng and along the Belabo-Satando-Mansa-Deng Deng axis have not yet started. They should be performed during year 0, before the effective launching of dam construction.

3.3.3.13 VA2 Access road operation

It corresponds to the current practices in terms of maintenance/ rehabilitation of any access road under the tropics.

3.3.3.14 TO1 Pipeline adaptation construction

The pipeline crosses the future reservoir in two different sectors. The first one corresponds to the Pangar crossing over a distance of 12.6 km and the second one to the Mbitel crossing, Mbitel, a right bank contributor to the Pangar over a distance of 12.4 km.

The works required are: laying down two new sections in a by-pass mode, compliant with the pipeline project and creating the connections between the new sections and the existing pipeline.

3.3.3.15 TO2 Operating pipeline adaptation

Just as was the case with the transmission line and the access roads, the most critical feature in the operation of this adaptation is the need to return periodically to strategic connections of the adaptation, a need that generates the obligation of a surveillance shared between COTCO, EDC and MINFOF.

3.3.3.16 IC1 Cumulative impacts

Beyond LPHP components – including its ESMP – major projects likely to generate cumulative impacts with the Lom Pangar dam project are:

- the planned hydroelectric projects in Nachtigal, Song Mbongue and Kikot,
- sand extraction in the Sanaga,
- the ALCAN (Rio Tinto) aluminum factory extension project at Edea,
- the Pont-Rail dam project on the Djerem, upstream of Mbakaou reservoir.

Those projects have been subject to a census and of a description of their potential impacts. Mitigating measures have been designed and it is proposed that EDC and the concerned developers jointly implement these.

3.3.3.17 MC1 Impacts of mitigating measures

The involuntary resettlement of the populations directly affected by the dam, the plant, the line, the creation of the DDNP and the access roads in the LPHP is described in the respective RAPs along with their mitigating measures.

The adaptation of the UTO and, more precisely the creation, in February 2010, of the DDNP constitute one of the major mitigating measures of LPHP, measure justified by the need to create a system protected from human interference allowing the conservation of animal species and more particularly large primates populations. This is done as an offset of the inevitable degradation of the biodiversity linked to the construction of the dam and the creation of the reservoir as well as of the ancillary infrastructure (power transmission, access roads, construction camps). The DDNP and the Mbam and Djerem National Park, just further away, will constitute a consistent network of protected areas, linked by the Djerem ecological corridor, an area with very low population density.

3.4 The present state of the environment in the project's area of influence

The area of influence of the project has been defined at two levels: the immediate surroundings of the project's infrastructure works for direct, indirect and induced impacts on the one hand and a huge area, mainly downstream of the Sanaga including its estuary, for cumulative impacts.

A full description of the area of influence has been performed, presenting its climate, geological features and resources, soils, seismicity risks, as well as hydrology and hydrogeology along with flora and fauna, both terrestrial and aquatic. Of particular ecological importance is the area immediately west of the dam, referred to in this report as « the UTO », an area rich in biodiversity , large primates in particular, inside which protected areas (the recently created

Deng-Deng National Park – DDNP -) presently coexist with forestry-dedicated (Forest management units or FMU) areas.

3.4.1 Biophysical description of the area of influence

Temperature and rainfall

The project is located in an area with a climate generally described as « subequatorial of Guinean type» with a bimodal rainfall pattern. The climatic data from the Betare Oya station show an average annual rainfall of 1,578 mm (extremes September 267 mm and December 7 mm) and an average annual temperature of 23° C.

Wind

Annually, 44.2 % of quiet time frequency, 26.3 % of south western winds and 7.7 % of Northern winds are observed.

Air quality

Given the very low present population density in the area, and the absence of any major polluting source nearby, it comes as no surprise that air quality is excellent.

3.4.2 Geology, seismicity

The Lom series is a monocline with a dominance of shale, more or less quartzitic with quartz lenses, more or less consistent with schistosity, apparently with gold content. That series presents a conglomerate structure at the basis.

Cameroon as a whole does not present much seismicity by world standards. However, a recent quake (march 2005) focused the attention on that risk.

Eastern Cameroon features a tectonic seismicity. It forms part of four areas of relatively high seismic frequency in the country: Mount-Cameroon area, Kribi and surroundings, the Adamaoua, Eastern Cameroon. Among others, seism has been recorded at Deng-Deng in 1913. However, following the German colonization, macro- and micro-seismic monitoring was not systematic anymore and there was no measurement of any seism from that time on.

3.4.3 Hydrology, hydrography, hydrogeology and water quality

Lom originates at the foot of Ngaou Ndal in the Central African Republic at the south-eastern boundary of the Adamaoua, around elevation 1,200 m, 70 km east of Meiganga and it slowly twists its way towards the confluence with the Pangar, its largest contributor, 23 km upstream of its confluence with the Djerem. 20-some km downstream of the site, the Lom and the Djerem unite to form the Sanaga. Downstream of the confluence with the Djerem, the Lom is the recipient of two main contributors on the right bank, the Ndjeke and the Mbam.

The valley downstream of the future Lom-Pangar reservoir can be presented as the succession of 3 distinct areas:

- Area 1: The Lom, from the dam down to the confluence with the Djerem: that 20 km section is the most directly exposed to the consequences of a dam failure,
- Area 2: The Sanaga downstream of the confluence between the Djerem and the Lom down to the confluence between the Sanaga and the Mbam. Upstream of Nachtigal, the average slope of the Sanaga is clearly accentuated, and the falls and rapids are more frequent,

- Area 3: The Sanaga downstream: from the confluence with the Mbam down, the Sanaga has practically no major contributor. The most important hydro electrical production sites, Edea and Song Loulou, are found in Area 3 that extends to the Atlantic Ocean. The Sanaga conserves a relatively steep slope in that area down to the Edea dam, where the estuary starts.

In the three areas, river utilization is limited to fishing, local boat navigation and sand extraction (Area 2 and 3 only).

The daily hydrological data for the Sanaga are available for the 1944-2002 period at Edea. Starting from 1970-71 (average flow around 1,800 m³/s) a hydrological deficit can be observed in comparison with the preceding 1944-1970 period (average flow around 2,400 m³/s). The evolution of the rebuilt inflows of Lom at the dam site over the 1952-2003 period shows a slow average decrease, from 290 m³/s down to 230.

As regards hydrogeology, the water tables recharge during the rainy season purely based on the percolation of runoff rainwater. The part played by the exchanges between water table and the river, with flow inversion between the water rise and fall, typical of alluvial plains, is limited because of the small sizes of those plains inside the Sanaga watershed. As a consequence, the water tables connected to the rivers are basically drained (rather than fed) by the rivers.

The waters of the Lom and the Pangar have a limited mineral content, presenting good physical and chemical features. No heavy metal has been detected, neither in the rivers nor in the sediments. In particular, mercury concentrations are very low.

3.4.4 Terrestrial biodiversity

The main natural habitats in the area of influence, described in more details in the body of the present ESIA report, are the semi-deciduous caducifoliated forests, the young and adult secondary forests, gallery forests, the moist semi-cleared forests humides and the grass, woodland and tree savannahs.

None of those habitats corresponds to a critical natural habitat as defined by OP/BP 4.04 of the World Bank; however, the loss by flooding of a large surface area of natural habitats requires an offset in the form of the DDNP.

Neither the semi-deciduous forests of Deng Deng nor the savannahs shelter significant quantities of rare species. In spite of the existence of some rare or vulnerable flora species, the patrimonial conservation challenge of flora species remains moderate and the LPHP does not significantly threaten the presence of endangered species in the area of influence. Conversely, the area of influence represents an interest for commercial logging trees.

As far as large mammals, five species have a conservation status requiring a specific attention in application of OP 4.04, in terms of host ecosystems:

- Gorillas, chimpanzees, black colobus monkey and pogonia vervets have been seen south of the Lom, outside the loop of the Lom Pangar,
- Over the past three years, elephants have stopped being seen in the area South of the Mbesse river; they are believed to occupy the area located between the Mbesse and Mararaba ; evidence of the presence of a few individuals has been recorded in the north-western part of UFA 10-065. Population size has not been precisely defined, but head count is probably of the order of a few individuals,

The presence of large apes is confirmed, the number of gorillas using the Deng Deng UTO being in the 100 to 200 range. Gorillas are found not only in the DDNP, but also in the Northern part of UFA 10-065 although the latter does not benefit from specific protection measures.

The corridor between DDNP and UFA 10-065 potentially plays a key role in the conservation of the above species, notably the gorillas, since they are presently blocked in their efforts to go north because of the presence of water streams.

The biological diversity of mammal species is high in the area; 68 species have been identified. They represent 54 % of large mammal species in the forests and savannahs nation wise.

Bird fauna is rich and diversified; 221 bird species have been found in one single month of observation. Most of the said species are typical of primary forests and have also been observed in of similar habitats in other regions of Cameroon. Conversely, savannahs have proven to be rather poor in species.

Most of the snakes, including the Gabonese viper, are captured and eaten in the villages. They represent an important protein source. Only two species of large reptiles are present in the area of influence:

- the varan dragon, very common in forest areas,
- the crocodile, which is intensively hunted and has practically disappeared, on the Lom as well as on the Pangar.

The analysis of the entomofauna produced valuable information pertaining to local biodiversity value based on a census of bio-indicative species. A sub-family of diurnal butterflies (Charaxinae) and two families of coleopterae (the Cetoniidae and Cicindelidae) have been selected. The Deng Deng forest hosts, all by herself one third of Charaxinae species in Cameroon. But these are all of species common or very common species that can be found in any forest, even, for most of the species, in degraded forests.

3.4.5 Aquatic biodiversity

The four categories of aquatic ecosystems in the area of influence are:

- Watershed heads,
- The small streams that flow into the Lom or the Pangar,
- The Lom and Pangar rivers: they can reach several tens of meters in width and several meters in depth,
- The wetland areas.

Probably because its high flows, the Lom has shown itself particularly poor in aquatic species. In the surveyed contributors, only two typically aquatic plants have been found: *Ottelia ulvifolia* and *Enhydra fluctens*.

Fish species

136 species, all strictly fresh-water have been identified in the Sanaga. 26 of these contribute in a significant manner to the present catches in the river. Among those, members of the Cyprinidae, Alestiidae, Cichlidae, Clariidae, Mormyridae, Mochokidae and Claroteidae families. Preferred habitats for these species have been identified and described.

At least 23 endemic species live in the Sanaga watershed.

Non fish aquatic species

Mainly made up of mammals and reptiles, they do not appear to have much evolved quantitatively these last years. Fisher people mainly mention hippopotamus and otters.

3.4.6 Populations and social organization in the area of influence

The population in the project's area of influence has been the subject of very few investigations and much data had to be gathered for the purpose of this ESA. The populations in the area of influence du project have been studied using a combination of surveys and direct analyses (in particular in the field of health) and of literature review. It appears that humans have been living in the area from ancient times on and that population densities have fluctuated much over the last centuries.

Settlement in the area of influence

It followed 2 broad sequences, (i) the expansion of local between the 18th and 19th centuries in the first instance, followed by (ii) the immigration of new groups. Three ethnic groups have settled in the area of influence during the first sequence: the Kepere, the Gbaya and the Pol. Traditionally, side by side with the already settled populations, new migrants arrive and are welcomed. In the Betare Oya area, this has been the case for Mbororo (and their cattle). In the southern area, in-migrants came from the Center and the East, all on the lookout for fertile agricultural land and forest resources such as wood and bush meat. The area of influence being a transition area north and south, new populations are drawn in for a variety of reasons. Those migratory flows have an impact on the recorded changes in the population structure of the region. With LPHP implementation, those population moves will only intensify. Actions and measures are proposed in this report to achieve balance between in-migration and local development in the area.

In the area of influence, villages are basically located along the communication axis.

Population density and location

The region has few inhabitants and wide spaces are basically empty. The most densely populated areas still have less than 10 inhabitants/km² and can be described as belonging to one of the following large sectors:

- Belabo – Carrefour de Mansa, the retained route for accessing the construction camp of the dam,
- Bertoua – Deng Deng, along RD 30, site of implantation of the future transmission line,
- the Deng-Deng area, which includes the Lom Pangar dam site and the villages directly downstream such as Lom 1, Lom 2 and Goyoum,
- the Betare Oya crescent area : along the Doyo – Tourake – Bangbel road, where population is located towards the reservoir's tail end,
- Mbitom – Tete d'Elephant, presently linked to the external world solely by rail or foot paths
- the tarred road sector between Betare-Oya and Petit Bello.

In addition to those 6 population sectors, scattered settlements exist and will develop around the reservoir; they will be utilized seasonally by the fishing communities.

Total population living in the area of influence is estimated at about 30,000 people.

Vulnerable populations

Women and three other human groups can be considered as particularly vulnerable on account of their limited adaptation capacities, or their mutual need for dependency, of their fragility or their specific needs. These are elderly people, children – orphans in particular – and sick and disabled people. They will need – and be given – specific attention and support as part of the ESMP.

Local authorities

The formal power authorities are represented at the regional level by the Governor, relayed by the « préfets » and « sous-préfets » at the levels of « départements » and « arrondissements ». That « modern » power structure is supported by the village and neighborhood chiefs and the elderly councils.

Living conditions and local services

Living conditions are generally mediocre:

- Dwellings are in majority thatch-roofed, brick or mud walls and mud floor. In the Deng Deng area, the dominant feature is mud walls. Altogether, tin roofs only constitute 20 % of the total,
- Only 13 % of population has access to drinking water. In majority, households access water sources in the wild, where water cannot be deemed safe for drinking,
- Kerosene lamps dominate as lighting means and fuel wood constitutes the bulk of energy use.

The equipments and services at populations' disposal vary greatly across areas. Two areas are worth mentioning:

- The railway area benefits from a relative abundance of collective infrastructure. It is, however, relatively isolated, railway constituting the principal access means,
- The area of unofficial villages located around the future reservoir, villages with very limited access to infrastructure and also little accessible.

Health

The area of influence is, a priori, not subject to huge food risks. However, the food regime is far from balanced, being rich in glucose and too low in vegetal proteins.

Health status in LPHP's area of influence is mediocre on the whole, both a consequence and a root cause of the weak local purchasing power. Basic hygiene rules are often not followed (hand cleaning after defecation, weak utilization levels for latrines, in particular), which reinforces the vicious circle by constituting one of the causes of recorded intestinal parasitoses and of typhoid fevers. According to the outcome of the studies conducted in 2010, malaria is the highest prevalence disease, affecting one individual out of two. Intestinal parasitoses constitute the second most frequent reason for consulting health specialists at the local level. The average rate of prevalence of ascaris in the surveyed villages is 37%. Onchocercosis also affects an important share of the local population. The prevalence rate is particularly high in Deng Deng (24%). The occurrence of the disease is also linked to the presence of wetlands where the insects inject the vector.

Cases of polyparasitism have been diagnosed in all medical facilities, combining intestinal, blood and skin parasites. Among 156 subjects infected with intestinal parasites, 42 only, or 26.9

%, are monoparasites. For the blood and skin parasites, most of the cases are monospecific infections; indeed, among the 211 surveyed persons exhibiting blood or skin parasites 96, or 45.5 % only carry one parasite specie.

Sexually transmitted diseases are borne by, according to the 2010 clinical analysis, 23.5 % of the population. The report from the regional and central administrations shows an HIV/Aids prevalence rate between 5% and 11% for East-Cameroon. Nationwide, women carry an estimated 6.7% vs. 4.1% among men. Surveys conducted in the Bertoua – Deng Deng area indicate a condom utilization frequency of 33%.

Other infectious diseases are abundant: diarrhea, respiratory infections among children, infections oto-rhino-laryngologic infections, eye diseases, odonto-stomatological infections. The highest infestation rates are found among the young population.

Tobacco use does not represent a huge public health issue in the area. Alcoholism, on the contrary, displays a significant rise, particularly linked to beer consumption in combination with consumption of local alcoholic beverages.

The LPHP area of influence is covered by two Health Districts (HD):

- Betare-Oya HD that includes the district hospital at Betare-Oya and 7 health centers covering 9 health areas,
 - Bertoua HD that includes 3 health centers covering 6 health areas,
- Government support to the health centers present in the area of influence is far from sufficient.

Land tenure and use

The extent of the cultivated/exploited areas varies according to the activities practiced by the population. They usually extend at the periphery of the villages in the savannahs and the valleys. Two land tenure regimes coexist in Cameroon:

- Modern land tenure regime, in particular via the Land Tenure Act of 1974, is based on the existence of official land titles,
- Customary land tenure regime is based on rules transmitted from one generation to the next one; it is dominant in the area of influence of LPHP.

Based on a compromise with the customary rights, the ruling law authorizes the application of ancestral usage rights of communities on the resources of forests where they dwell.

The other critical economic activities in the area are agriculture (practiced by practically all households), sedentary and itinerant livestock, and hunting, essentially for domestic consumption; artisanal gold digging, typically an occupation of the young is gaining momentum as a solution to the economic crisis. Other activities include fishing and illegal timber trade, using the railroad towards North Cameroon.

The environmental pressure resulting from hunting is high, especially since it is being practiced outside the law: no firearm holding permit, non-observation of any hunting, animal protection or trading rules.

Incomes

For households with agriculture as the main stand, annual incomes are usually in the 330,000 CFAF (500 €/year) to 750,000 CFAF (1,150 €/year) bracket. In the area as a whole, income per household is evaluated at 341 KCFAF, the most important elements – providing 80 % of the total – are agricultural products (food items 115 KCFAF, 34 %), gold production (96 KCFAF, 28

%) and fishing (65 KCF AF, 19 %). The remaining sources provide 20 % of total income: 20 KCF AF for livestock (6 %), 19 KCF AF (6 %) for craft and other cottage activities, 12 KCF AF for trade and 8 KCF AF for hunting (including 340 CF AF via pocking). The *per capita* monetary income for a household composed on the average of 2.5 adults and 2.8 children is 130,000 CF AF.

The economic activities in the area of influence are supported by various public sector and civil society (NGO) organizations. That support is, however, far from sufficient and confirms the belated development of the Eastern region vs. the rest of the country.

Cultural and archeological resources

One final note is about the richness of archeological resources in the area. According to the data collected during the preliminary investigation in 2005 and the supplementary mission in 2010, in the northern sector (between Deng Deng and Betare Oya), a total of 72 sites has been surveyed, identified and described over a distance of about 140 km, i.e. a density of 1 site every second kilometer.

3.5 Project's potential impacts and their mitigating measures

A uniform approach has been used for the identification and characterization of impacts.

The identified impacts may be direct or indirect, positive or negative, occur in the short, medium or long terms, have a permanent or temporary effect, be reversible or irreversible, and/or cumulative. To assess the degree of seriousness of those impacts, the best attempts have been made to assess its more or less significant nature.

To that end, each impact has been characterized using the following categorization: major, moderate, minor and neglectible/none, be the impacts negative or positive. Consistent with the ESIA of the adaptation of the pipeline, the following terminology has been used.

Principles for impact categorization

Category	Significance
Major	The potential impact is unacceptable. Mitigating or compensation measures are mandatory.
Moderate	The impact is perceptible and undesirable. It is strongly recommended to implement mitigating or compensation measures.
Minor	The impact is not very important, but should still be minimized by appropriate mitigating or compensation measures.
Neglectible/none	The impact is hardly perceptible/measurable and/or can be tolerated.
Positive	The impact is linked to environmental/social benefits or the project improves the environment/the fate of local populations as compared with the initial situation and the negative impact is neglectible or none

The categorization is established via expert opinion on the basis of a combination of the following criteria:

- Likelihood of impact occurrence,

Lom Pangar Hydroelectric Project ; Environmental and social assessment (ESA). Executive summary. March 2001.

- Value perceived by the stakeholders,
- Spatial dimension of the impact,
- Temporal dimension of the impact,
- Scope of changes to the environment or to local populations,
- Compliance with applicable laws and standards.

This analysis method is also identical to the method used for the specific ESIA conducted for the adaptation of the pipeline on behalf of COTCO.

Hereafter is a synthesis of the identified and characterized impacts.

Legend - : negative impacts + : positive impacts
 P : Physical environment B : Biological environment SE : socio-economic aspect C : Cultural aspect
A cell has been grayed whenever an impact concerns the theme in question

Phase works\impacts characterization	Major		Moderate		Minor		Neglectible	
BR3 <i>Camp construction</i>	<ul style="list-style-type: none"> - Increased poaching - Increased STD/AIDS transmission risks 	P	<ul style="list-style-type: none"> - Natural habitat loss - Air pollution - Soil pollution - Water pollution - Accident risks + Job creation 	P	<ul style="list-style-type: none"> - Impacts on soils - Flora and crop destruction 	P		P
		B		B		B		B
		SE		SE		S E		S E
		C		C		C		C
BR4 <i>Dam construction</i>	<ul style="list-style-type: none"> - Increased poaching - Increased STD/AIDS transmission risks - Increased frequency and intensity of social conflicts - Forced population moves + Job creation - Impacts on 	P	<ul style="list-style-type: none"> - Natural habitat loss - Air pollution - Soil pollution - Water pollution - Accident risks - Let go of traditional activities - Increased pressure on food and basic services - Decrease in traditional power structure - Rise in village-level land claims - Increased cost of living 	P	<ul style="list-style-type: none"> - Impacts on soils - Flora and crop destruction 	P		P
		B		B		B		B
		SE		SE		S E		S E
		C		C		C		C

Phase works\impacts characterization	Major		Moderate		Minor		Neglectible	
	heritage and cultural activities							
BR5 <i>Clearing works / logging before flooding</i>	- Increased poaching - Natural habitat loss	P	- Impacts on soils - Water pollution Overlogging at the periphery of the reservoir - Accident risks - Increased STD/AIDS transmission risks - Squatting risks - Rise in village-level land claims - Increased cost of living	P	- Air quality degradation	P		P
		B		B		B		
		SE		SE		SE		
		C		C		C		
BR6 <i>Tourake bridge construction</i>		P	- Increased local human pressure on natural habitats - Significant increased cattle presence on a single passage - Animal health risk increase + Improved Lom crossing + New development opportunities	P	- Air pollution - Soil pollution - Water pollution - Accident risks + Job creation - Decreased trade at alternative crossing locations	P		P
		B		B		B		
		SE		SE		SE		
		C		C		C		
BR7 <i>Dam and reservoir operation</i>	- Increased poaching - Natural habitat loss - Lowering in water quality	P	- Impacts on climate - Impacts on agriculture and livestock - Impacts on heritage and cultural activities + Job creation	P	- Impacts on induced on the seismicity - Impacts Sanaga estuary	P		P
		B		B		B		
		SE		SE		SE		
		C		C		C		

Phase works\impacts characterization	Major	Moderate	Minor	Neglectible
	<ul style="list-style-type: none"> - Altered aquatic fauna composition - Accident Risks - Increased STD/AIDS transmission risks - Drowning risks - Let go of traditional activities - Impacts on mine operation - Impacts on gathering, hunting and logging activities - Impacts on transport infrastructure - Dam failure risks - Impacts on landscapes 	<ul style="list-style-type: none"> + Fishing activity development - New cropping opportunities on the water fluctuation areas + Opening of the area's access 		
BR8 <i>Dam removal</i>		<ul style="list-style-type: none"> - Risks associated to any large scale civil work - Dam downstream flooding risks - Significant alterations of the hydro-biological balance 		
	P		P	P
	B		B	B
	SE		SE	SE
	C		C	C

Phase works\impacts characterization	Major		Moderate		Minor		Neglectible	
		B	downstream in the Sanaga	B		B		B
		SE	- Impacts on fisheries	SE		S		S
		C	- Large quantity of rubbles needing recycling	C		E		E
						C		C
UP1 <i>Power plant construction</i>	See BR4 dam construction	P	See BR4 dam construction	P	See BR4 dam construction	P		P
		B		B		B		B
		SE		SE		S		S
		C		C		E		E
						C		C
UP2 <i>Power plant operation</i>	+ Re-oxygenation of downstream water by the plant	P		P	- Water pollution	P		P
		B		B		B		B
		SE		SE		S		S
		C		C		E		E
						C		C
LT1 <i>Transmission line construction</i>	- Loss of forest areas between Deng-Deng and the power plant located at the dam	P	- Water pollution	P	- Impacts on soils	P		P
		B	- Localized wetland destruction	B	- Air pollution	B		B
		SE	- Natural habitat loss	SE	- Noise	S		S
		C	- Increased STD/AIDS transmission risks	C	- Biodiversity loss	E		E
			- Increased road accident risks		- Destruction of non-wooded forest products	C		C
			- Localized drinking water supply degradation		- Ecological corridor temporary disturbance			
			- Cropped area loss		- Impacts on landscape			
			- Localized sacred site loss					
			+ Job creation					

Phase works\impacts characterization	Major		Moderate		Minor		Neglectible	
			+ Improved living conditions		- Increased frequency and intensity of social conflicts - Dwelling losses			
LT2 <i>Transmission line operation</i>		P		P	- Ozone emission - Wave-linked diseases - Electrocutation - Fire hazards	P	- Noise	P
		B		B		B		
		SE		SE		SE		
		C		C		C		
VA1 <i>Access road construction</i>	- Impacts on cultural heritage + Improved living conditions	P	- Water pollution - Impacts on soils - Deforestation - Impacts on fauna - Increased frequency and intensity of social conflicts - Increased STD/AIDS transmission risks - Loss of traditional power - Impacts on public safety + Temporary increase in earnings for local populations	P	- Air pollution	P		P
		B		B		B		
		SE		SE		SE		
		C		C		C		
VA2 <i>Access road operation</i>	- Impacts on fauna - Illegal logging development	P	- Increased STD/AIDS transmission risks - Accident risks - Sedimentation in	P	- Waste oil spill risks	P		P
		B		B		B		
		SE		SE		SE		

Phase works\impacts characterization	Major		Moderate		Minor		Neglectible	
		C	downstream water beds + Improved living conditions	C		C		C
TO1 <i>Pipeline adaptation construction</i>	<ul style="list-style-type: none"> - Increased poaching - Natural habitat loss - Population influx - Impacts on public safety at village crossings - Criminality risks from uncontrolled origin - Impacts on hunting + Job creation 	P	<ul style="list-style-type: none"> - Air pollution in inhabited areas - Noise - Impacts on soils - Water pollution - Impacts on surface water flows - Impacts on flora - Impacts on aquatic habitats and fauna - Impacts on landscapes - Increased frequency and intensity of social conflicts - Increased STD/AIDS transmission risks - Localized drinking water supply degradation - Impacts on public safety - Restriction of access to some areas - Impacts on agriculture and livestock for the Biboko village and for Mbororos - Impacts on fisheries 	P	<ul style="list-style-type: none"> - Air pollution outside inhabited areas - Impacts on the water table - Risks of pipeline sabotage - Impacts on agriculture and livestock 	P		P
		B		B		B		
		SE		SE		SE		
		C		C		C		
TO2 <i>Operation of the interface pipeline-</i>	<ul style="list-style-type: none"> - Oil spill risks of in the reservoir - Impacts on terrestrial fauna 	P	<ul style="list-style-type: none"> - Impacts on vegetation - Risks of physico-chemical water pollution - Risks of accidents 	P	<ul style="list-style-type: none"> - Air pollution - Impacts on landscapes - Increased 	P	- Impacts on soils	P
		B		B		B		
		SE		SE		S		

Phase works\impacts characterization	Major		Moderate		Minor		Neglectible	
<i>reservoir</i>	<ul style="list-style-type: none"> - Impacts on aquatic flora and fauna - Impacts on fisheries 	C		C	frequency and intensity of social conflicts	E C		E C

3.6 The public consultation process

A LPHP stakeholder analysis was conducted and led to the design of the following.

Stakeholder analysis

Stakeholder groups	Stake vis-a-vis LPHP	Effect of the project on interests	Importance of stakeholder in project success	Degree of influence of stakeholders on the project ⁸
State	Water and Electricity	Positive	Major beneficiary	5
Industry	Water and Electricity	Positive	Major beneficiary	3
Eastern Region	Electricity	Positive	Major beneficiary	4
Local NGOs	Power/income	Positive if involved	Important player (Potentially beneficiary)	3
Villagers/farmers	Agricultural area, land bank, fishing, hunting, gold, picking	Negative on the whole	Main or secondary victim	2
Unofficial camp dwellers	Living area	Negative	Main victim	1
Hunters	Activity areas	Negative	Main or secondary victim	2
Local fishermen	New fishing locations and techniques	Negative (traditional techniques) and positive (resource enhancement)	Victim and beneficiary	1
Outside fishermen	Fish resource	Positive	Beneficiaries	1
Herdsmen	Pasture, transhumance areas	Variable	Victim	2
Gold diggers	Decreased number of sites (Mines)	Negative (partial flooding of the ore) Positive (structuration of the activity)	Victim and beneficiary	2
Vulnerable groups	Loss of protein supply	Negative	Victim	1

3.6.1 Information and consultation during the preparatory studies

During the preparation of the LPHP, the communication means selected were adapted to the information scale targeted:

- At the international level, information was disseminated using the IUCN Internet site, World Bank's, international media and the EDC Internet site,
- At the national level, information was disseminated via the national official and private press organizations and during the information meetings to which the national and international press representatives were invited,
- Regional information has been disseminated through the local press, the action of which is complemented by meetings targeted local authorities, « chefs de canton » and « chefs de village », opinion leaders, elites, NGO and other interested parties,
- At the local level, meetings in all villages were set up during the EIA and public auditions were organized by MINEP.

⁸ 1= Lesser 2= Weak 3=Moderate 4= Important 5=Key actor

The most critical information and consultation activities implemented during the EIA were:

- January 2004 through 2005 : Launching workshops followed by collaborative and information meetings in 60-some sites in total, targeting the while of local populations as well as smaller groups like women or agriculturist living close by the future reservoir (Northern Betare Oya sector),
- Starting in April 2005, the outcome of the ESIA were presented to the local populations, NGOs and regional/national administrative authorities,
- In 2009, faced with evolutions in project, ESIA and ESMP designs, a new cycle of information and local populations consultation was put in place,
- In 2010, the launching of the retrofitting of LPHP environmental and social studies was the opportunity to organize, on February 3rd, an interactive workshop in Yaoundé, in which about 100 representatives from civil society, the Cameroonian administration, including several from the local and/or regional administration as well as from the private and parastatal sectors,
- MINEP, with EDC support, organized a second round of public consultations during January/February 2011 in Yaounde, Bertoua, Belabo, Betare-Oya, Garga Sarali and Deng Deng.

The main outcomes of these consultations, as well as the concrete responses provided by the project, were systematically recorded, are summarized in the body of this report and presented in more detail in annex 11 of the ESIA.

Hereafter is a list of upcoming information and coordination meetings to be held in the framework of the ESA process.

Upcoming information/consultation actions

Action	Planned timeline	Scope
In the framework of ESA		
World Bank Internet (InfoShop) dissemination of LPHP environmental and social documentation: ESIA, RAPs, ESMP, Cumulative Environmental Impact Assessment (CEIA) and Regional Development Plan (RDP)	March 2011	International/National/Regional
Dissemination of paper versions of LPHP environmental and social documentation : ESIA, RAPs, ESMP, CEIA and RDP	March 2011	National/Regional/Local
Announcement in Cameroon national press of the online availability of LPHP environmental and social documentation and invitation to comment by one and all.	March 2011	National/Regional/Local
Finalization of EDC's communication strategy	March 2011	Regional/Local
Continuation of consultations by EDC regional level information meetings (organizing a workshop in Bertoua)	March 2011	Regional/Local
Second cycle of public auditions by MINEP integrating World Bank safeguard policy principles	March/April 2011	Regional/Local
Dissemination by MINEP of public audition proceedings	April 2011	National
Updating ESIA and ESMP documentation on the basis of public audition and Bertoua workshop outcome	May 2011	International/National/Regional
During the construction works and during the operational phase		

Action	Planned timeline	Scope
Implementation of EDC's communication strategy	2011 to 2013	Regional/Local
Periodic local population consultation, on an informed, prior and free basis, on ESMP and RAPs implementation and on annual programming of the corresponding activities.	2012	Regional/Local
National dissemination and Internet publication of dam construction expert panel reports	2012	International/National/ Regional
Periodic local population consultation, on an informed, prior and free basis, on ESMP and RAPs implementation and on annual programming of the corresponding activities.	2013	Regional/Local
National dissemination and Internet publication of dam construction expert panel reports	2013	International/National/ Regional
Periodic local population consultation, on an informed, prior and free basis, on ESMP and RAPs implementation and on annual programming of the corresponding activities.	2014	Regional/Local
National dissemination and Internet publication of dam construction expert panel reports	2014	International/National/ Regional

4 ESMP CONTENT

On the basis of the analyses conducted and summarized in volume 1 of the ESA (ESIA), an environmental and social management plan (ESMP) has been designed and proposed in volume 2. The ESMP covers in detail an initial 8 year period and incorporates provisions for the thereafter continuation of mitigation and impact minimization actions, consistent with World Bank's safeguard policies. Aspects directly linked with compensation and resettlement are dealt with separately in the RAPs.

The ESMP adopts a holistic approach and covers all LPHP components during its preparation, implementation and removal phases:

- Lom Pangar dam and associated reservoir
- Hydropower plant and electric transmission line
- Access roads
- Pipeline adaptation works and maintenance
- Interactions with other local and regional projects in as much as they jointly generate cumulative impacts
- Environmental and social impact mitigating measures

4.1.1 ESMP objectives

They are essentially:

- Minimize the negative environmental and social impacts of infrastructure construction and operation of LPHP in its area of influence,
- Put in place a sustainable natural resource management system in LPHP area of influence, directly and through a biodiversity offset,
- Protect population living in LPHP area of influence and ensure that all, including vulnerable groups, maintain cultural, economical and health conditions equivalent, during and after the project, and if possible better, than their present conditions.

Implementing LPHP will contribute significantly to poverty reduction in Cameroon. However, LPHP approval hinges on its compliance with national environmental and social requirements as well as with World Bank's safeguard policies.

The ESMP incorporates actions aiming at enhancing EDC and GoC capacities to protect the environment and local populations, thus minimizing the potential negative effects of LPHP on society and the environment. The ESMP will, in particular, support the implementation of prevention and management programs on public and workers' health cultural heritage protection, support and monitoring of biodiversity conservation programs as well as information sharing.

Prevention and protection measures proposed in the ESMP include:

- utilization of appropriate norms, standards, specifications and practices for the construction and operation of the hydraulic and civil works, as well as,
- the control, by both EDC and GoC, of the application of these norms, standards, specifications and practices,
- the implementation and the monitoring of a biodiversity conservation project providing support to the protection and management of the Deng-Deng National Park (DDNP) and, more generally, UTO adaptation,

- The implementation and monitoring of actions in favor of the local communities affected by the project.

4.1.2 Proposed ESMP institutional arrangements

It describes the interactions between Electricity Development Corporation (EDC) and the following organizations:

- Central administrations, directly or through their delegated operators,
- GoC's regional delegations coordinated by the Eastern Region Governor,
- COTCO,
- The contractors in charge of dam and ancillary infrastructure construction and maintenance.

EDC is already equipped with (i) an E&S technical advisor to the General Manager and ii), under the authority of the Lom Pangar Project Director, a Sub-Directorate for safety, environment and regional development (SDSED) that will supervise the implementation and the monitoring of the ESMP.

The main administrations concerned are MINFOF, in the first line of fire for the UTO adaptation (in particular DDNP management in cooperation with its technical assistance), but equally for the surveillance of reservoir area clearing and logging and for fighting poaching, MINEP and MINEE (the latter co-ensures, along with the Ministry of finance, EDC's umbrella).

LPHP's Monitoring, Facilitation and Accompaniment (in French, CSFA) will, once appropriately endowed, ensure the coordination of the actions of the Regional Directorates of several key administrations under the joint responsibility of the Eastern Region Governor and EDC.

Last but not least among established groups, the relations with COTCO, essential both for the smooth implementation of the pipeline, but also for the surveillance of access points and for the prevention and intervention in case of oil spills, are being finalized in the framework of an Interface Agreement (IA) which is being ratified.

Contractors' responsibilities are detailed in the ESMP construction, appended to volume 1 ESIA and also have been the subject of environmental and social terms of reference (CCES in French), a document that has been integrated into the works' call for bids. These terms of reference contain, in particular, a description of the penalties to force upon the contractors in case of environmental or social non-compliance. The CCES applies to the dam, but also, in full right, to all infrastructure construction work in LPHP.

4.1.3 ESMP summarized description

The implementation of ESMP, assuming that it follows the prescribed schedule and mobilizes the required means will contribute to addressing three major challenges: works' sustainable management, UTO adaptation and an optimal support to local populations.

The ESMP requires the implementation of four components, all required to aim at compliance with the seven safeguard policies triggered by LPHP:

- Component 1 : Environmental and Social Management of dam and other infrastructure construction and operation
- Component 2 : Adaptation of Deng Deng UTO
- Component 3 : Support to local populations

▪ **Component 4** : ESMP implementation

A priori, the vast majority ESMP activities will be financed EDC using part of the income of the future « water tax», but it is clear that some key actions, such as research and development in DDNP, fishery development in and around the reservoir, etc. will only, at best, be co-financed by EDC.

The cost of implementing the ESMP has been estimated at 40 billion CFAF (60 million €) w/o miscellaneous and inflation. The costs by component are also provided with the same caveat.

The breakdown of ESMP activities is as follows:

Component 1: Environmental and Social Management of dam and other infrastructure construction and operation

It aims to address the challenge of works' sustainable management and is comprise of the following sub-components:

1.1 E&S Management during the construction phase

1.1.1 Contractor oversight

1.1.2. Public health management during construction

1.1.3. Archeological and cultural heritage preservation

1.1.4. Pipeline adaptation impact management

1.1.5. Dam safety management during construction

1.1.6. Miscellaneous E&S management during construction

1.2 E&S Management during the operation phase

1.2.1 Reservoir clearing and logging E&S management

1.2.2. Support to fishery management

1.2.3. Contribution to the management of cumulative impacts

1.2.4. Reservoir's sustainable management

1.2.5. Dam safety management during operation

1.2.6. Miscellaneous E&S management during operation, including financial provision for beyond Year 8

Component 2: Adaptation of Deng Deng UTO

It is comprised of:

2.1. Prior activities

2.2. Support to DDNP management

2.3. Support to the management outside DDNP area

Component 3: Support to local populations

This component essentially deals with territories outside the UTO and under the direct authority of the Eastern Region Governor. Component 3 is comprised of:

3.1. Public health management during operation

- 3.2. Preventive conflict management
- 3.3. Support to local sustainable development
- 3.4. Other local actions

Component 4: ESMP implementation

It is indispensable and fully synergetic with the other (« substantive ») ESMP components and is comprised of:

- 4.1. Institutional capacity enhancement
- 4.2. Independent Panel
- 4.3. Monitoring
- 4.4. ESMP administration and control

4.1.4 ESMP planned implementation

The ESMP will start implementation as soon as LPHP ESA has been approved by Cameroonian authorities and donors.

The ESMP is presented as a 8 year program and the ESMP process includes i) actions immediately needed on the ground that several prior pre-dam construction activities are already being implemented and ii) provisions made to ensure that the required prevention, mitigation and compensation measures as well as ESMP implementation monitoring continue beyond year 8 of LPHP.

Civil society will play a key role in ESMP implementation at three levels: as catalyzer for local development, as active « whistle blower » of LPHP actions' compliance with the safeguard policies and, eventually, as operator. In the same vein, the Cameroonian private sector also should attempt to expands its business by contributing to ESMP implementation, notably in the civil works, office equipment, telecoms, miscellaneous supplies and services, transports, possibly ecotourism (depending on DDNP policies in this area). Conversely, the same national private sector should be discouraged from pursuing and further developing illegal activities, however lucrative in the short term. There again, GoC and EDC should send clear signals to the private sector and, at least during the first years of ESMP implementation, help that private sector as reasonably required.

Implementation cost of the ESMP

It is presented as a summary in the table thereafter.

		Year							
Total by component	Total	1	2	3	4	5	6	7	8
1. Dam and ancillary infrastructure	21 272	1 324	1 061	2 577	1 430	967	565	565	12 783
2. UTO adaptation	5 719	1 670	576	558	530	641	606	579	559
3. Support to local populations	5 297	1 311	833	526	526	514	552	518	518
4. ESMP Implementation	7 724	1 655	1 091	1 328	770	515	491	593	1 282
Total	40 012	5 960	3 561	4 988	3 256	2 636	2 214	2 255	15 142