PROJECT: SINGROBO-AHOUATY HYDROPOWER PROJECT (44 MW)
COUNTRY: CÔTE D'IVOIRE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SUMMARY (ESIA)
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<table>
<thead>
<tr>
<th>Project Title: 44 MW Singrobo-Ahouaty Hydropower Project</th>
<th>SAP Code: P- CI-FAB-001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country: Côte d’Ivoire</td>
<td>Department :</td>
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<td>Division : RGDW1</td>
<td>Submission Date: 30/09/2017</td>
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<tr>
<td>Environmental and Social Safeguards: M. Kinane/C. Mhango</td>
<td></td>
</tr>
</tbody>
</table>

**Introduction**

This document is the summary of the Framework Environmental and Social Impact Assessment (ESIA) of the 44MW Singrobo-Ahouaty Hydropower Project. In accordance with the International Safeguards System (ISS) of the African Development Bank (AfDB) and national requirements, this project was classified as Category I. This summary was prepared in compliance with AfDB’s environmental and social assessment guidelines and procedures for project’s in that category.

First, the project description and rationale are presented, followed by the legal and institutional framework in Côte d’Ivoire. A brief description of the main conditions in the project area is then presented through its physical, biological and human components. Technological options are available and are compared in terms of technical, economic, environmental and social feasibility. This is followed by a presentation of the most significant positive and negative impacts on the biophysical and human environments (socio-economic). It should be noted that these impacts are those which are anticipated, irrespective of the type of solar plant and those concerning related infrastructure. The proposed enhancement and mitigation measures are then presented to optimize the benefits and /or prevent, minimize, mitigate or offset the negative impacts. The monitoring programme is also presented. A summary of climate change-related risks accompanied by adaptation and mitigation measures are proposed. The public consultations held are presented as well as complementary initiatives linked to the project. Finally, the existing capacities of the implementation unit are analyzed.

1. **Project Description and Rationale**

1.1. **Project Rationale**

The Government of Côte d’Ivoire intends to invest heavily in the generation, transmission and distribution segments of the electric power sector and to implement an ambitious electrification programme for 2100 villages at a rate of 700 villages per year over a three-(3) year period. The success of this project of a social nature requires the lowest possible cost price of energy. This is the reason for the Government’s decision to construct the Soubre hydropower plant and its determination to develop the means of generating hydropower. It is against this backdrop that Ivoire Hydro Energy Ltd (IHE), sponsor of the Singrobo-Ahouaty Hydropower Development Project on the Bandama River, proposes to contribute to the diversification of the country's generating means and the reduction of the cost price per kWh while implementing environmental protection measures.

1.2. **Project Description**

The project comprises the design, construction and operation of a 44 MW hydro-power plant on the Bandama River, close to the villages of Singrobo and Ahouaty in Côte d'Ivoire. The project anticipates annual production of 217 GWh and will operate with a load factor of 56%. It also addresses the Government’s concern to diversify the energy mix following an increase in thermal
power generation in recent years. The project increases the proportion of renewable energies while improving the sector’s financial viability.

The Singrobo-Ahouaty Hydropower Development Project comprises two main components:

(i) The primary installation comprising the main dam, the water intake structure, the spillway, power plant and tailrace channel; and

(ii) Related infrastructure comprising transmission lines and the interconnection substation.

The primary installation comprises the following components:

- A 23.50 metre high x 1246 metre long main dam composed of two sections: i) a 1015 metre long earth and rockfilled dam with a waterproofing geomembrane system upstream from the dam; and ii) a 134-metre long roller compacted concrete dam on the left bank of the water intake structure;
- A reservoir with a 105 hm³ capacity with serving sides between 65.5 m and 62.5 m above sea level;
- A concrete spill way on the left bank of the river, large enough to clip off a 2.745m³/s flood discharge corresponding to 10,000 year flood occurrence;
- A water intake structure composed of two sluices and sized to allow a 211m³/s design flow and two steel lined pen stocks incorporated in the dam structure;
- An external plant at the foot of the dam on the left side of the river, equipped with two horizontal axis Kaplan turbines coupled with two 22MW alternators, working with a 26.58m gross head;
- A tail race canal approximately 1.3km long to discharge the turbined water into the Bandama River; and
- Several camp facilities including an O&M site, a workers camp site, living quarters and other temporary facilities.

Associated infrastructure comprising the following: –

- A substation located near the power house to evacuate power at 90kV;
- A 3km long dual transmission line connecting the existing 90kV Taabo-Agboville transmission line; and
- Two camp sites including a command site and housing units.

The facilities will be constructed over a 34-month period including 3 months to fill the reservoir and for pre-commissioning testing. The construction works on the hydro-power facilities will be implemented in two (2) main phases during which river water control will remain the main challenge for the security of the structures and assets. The work area protection structures are cofferdams composed of rockfill with a clay core and are intended for a design flood with a 25-year return period.
As regards the sources of materials it is worth noting that the project was designed to optimize the use of natural resources. Thus, the materials excavated to dig the tailrace channel will be used to construct the rock-filled dam. If necessary, and if the materials excavated from the tailrace channel are insufficient to complete the dam, back-up quarries will be used which will be located close to the site in the reservoir right-of-way in order to avoid any additional impact.

1.3 Project Location

The project’s direct area of influence covers land/villages affected by the dam, the power plant, water intake, spillway, tailrace channel, reservoir, access roads, interconnection sub-station, power transmission lines and the necessary installations for the construction and operation of the hydropower plant. This area of influence comprises the following 5 villages in the Taabo and Pacobo sub-prefectures; Singrobo, Ahouaty, N’denou, Pacobo and Ahéremou.

The indirect area of influence covers Taabo Department as well as the forests of Singrobo and Goudi, the LAMTO reserve, the upstream areas between the Taabo dam and the project site and the downstream area between the project site and the exit from the Bandama watershed.

Figure 1
Geographical Location of the Singrobo-Ahouaty Hydropower Development Project
2. **Policy, Legal and Administrative Framework**

2.1. **Applicable National Regulatory Texts**


In accordance with the environmental regulation approach adopted and presented in this summary, the emission limits retained during the project construction phase are obtained from the emission grids proposed in the Ivorian legal texts (implementing decrees and draft orders for emission thresholds). In the case of certain parameters, additional guidance is provided by the World Bank Group General Environmental Health and Safety Guidelines and the recommendations of the World Commission on Dams.

2.2 Institutional Framework

The main institutions concerned by the Project are:

- **Ministry of Oil, Energy and Renewable Energy Development (MPEDER)** - is responsible for conventions and agreements relating to the environment. It prepares the information/education/communication strategy with the private sector, NGOs and Grassroots Community Organizations (GCO) in the field of the environment.
  - The National Environmental Agency (ANDE) is a company under the oversight of MINEDD which intervenes in the project’s environmental certification on behalf of its oversight Ministry, during the project’s design, implementation and monitoring. It is also responsible for the validation of this ESIA and the project’s environmental monitoring;
  - The Ivorian Parks and Reserves Authority (OIPR) is a structure under the oversight of MINEDD responsible for the protection of the LAMTO Reserve located near the planned right-of-way, which will be carried out by it.
  - The Ivorian Anti-Pollution Centre (CIAPOL) will monitor the quality of water resources (Bandama River and its tributaries) once the dam is operational.

- **Ministry of Water Resources and Forests (MINEF)** is responsible for the implementation and monitoring of the Government's policy on the protection of water and forests. It ensures the protection and development of forest, aquatic, river, lagoon and coastal ecosystems and wetlands. Through its Water Resources Department (DRE), MINEF will contribute to the protection of the water resources on which the Singrobo-Ahouaty dam will be constructed, namely the Bandama River during the project’s implementation. The Forest Development Company (SODEFOR) will participate in the protection of forest resources located near the project’s planned right-of-way during its implementation;

- **The Ministry of Livestock and Fishery Resources (MIRAH)** is responsible for implementing and monitoring the Government’s livestock and fishery resources policy. Under this project, MIRAH will intervene in the management and sustainable
use of species of the aquatic ecosystem (Bandama River and tributaries) present in the project area especially in terms of fishing.

- **Ministry of Agriculture and Rural Development (MINADER)** is responsible for the preparation and implementation of agricultural policy in Côte d’Ivoire: food security, plant protection, enhancement of agricultural products, rural poverty reduction in harmony with environmental protection, etc. MINADER will be responsible for managing compensation for the different crops destroyed during the project’s implementation.

- **Ministry of Construction and Urban Planning (MCU)** is responsible for the design and implementation of Government policies in the areas of urban planning, land use and the protection of sensitive areas. The MCU will manage compensation for buildings that are destroyed and the possible resettlement of people and property in the project right-of-way;

- **Ministry of Economic Infrastructure (MIE)** is responsible for implementation of the Ivorian government’s policy regarding the country’s public works infrastructure. The MIE will be responsible for the construction of the project’s access roads.

- **The Ministry of Industry and Mines (MIM)** is the main official interlocutor of mining operators. It designs and coordinates the implementation of the country’s mining policy. It has oversight over all the mining activities on the national territory. It will intervene by operating the existing borrow pit site(s) or possibly to open new ones during the project’s implementation.

- **Ministry of Health and Public Hygiene (MSHP)** is responsible for the implementation and monitoring of Government policy in the areas of health and public hygiene. The MSHP will contribute to the sensitization of site personnel and local communities regarding public hygiene and HIV-AIDs control.

- **Ivoire Hydro Energy Ltd (IHE)** is an Ivorian limited liability type company with a Board of Directors established in February 2012, to sponsor the Singrobo-Ahouaty Hydropower Plant Development Project on the Bandama River. More generally, the goal of IHE is to design, finance and operate new and renewable energy infrastructure, in particular, in the areas of hydropower and electric power grids;

- **Société des Energies de Côte d'Ivoire (CI-ENERGIES)**, a structure under the oversight of the Ministry of Oil and Energy (MPE), was established by Decree 2011-472 of 21 December 2011. The Société CI-Energies will supervise on behalf of the central government of Côte d’Ivoire and, more specifically, on behalf of its oversight ministry (MPE) the project’s design, implementation and monitoring.

### 2.3 Safeguard Policies of the African Development Bank (AfDB) applicable in the context of this project

The Integrated Safeguards System (ISS) through its five operational safeguards (OS):

- **Operational Safeguard 1**: Environmental Assessment: this operational safeguard is triggered since this is an investment project subject to a de facto environmental and social impact assessment;
Operational Safeguard 2: Involuntary Resettlement – this operational safeguard is triggered since the project entails resettlement;

Operational Safeguard 3: Biodiversity, Renewable Resources and Ecosystem Services: this operational safeguard is not triggered since the project does not affect areas with biodiversity or ecosystem services potential.

Operational Safeguard 4: Pollution Prevention and Control, Greenhouse gases, hazardous materials and efficient use of resources: This operational safeguard is triggered since there is a risk of various types of pollution and contamination during the works; and

Operational Safeguard 5: Working Conditions, Health and Safety: this operational safeguard is triggered since there are risks to the health and safety of workers during implementation of site-related works.

In addition, other relevant policies and guidelines of the Bank shall remain applicable as soon as they are triggered under the ISS. These include:

- The Bank’s Gender Policy (2001);
- Framework for Enhanced Engagement with Civil Society Organizations (2012);
- Policy on Disclosure and Access to Information (2012);
- Handbook on Stakeholder Consultation and Participation in AfDB Operations (2001);
- Bank’s Policy on Population and Strategies for Implementation (2002);
- Bank’s Integrated Water Resources Management Policy (2000); and

2.5. Other International Texts


The basic studies were also conducted taking into account the environmental and social safeguard policies of other potential donors including the World Bank, IFC and EIB.
3 Description of the Project’s Environment

3.1 Definition of the Study Area

The direct area of influence comprises the reservoir and the rights-of-way planned for the dam, the spillway, the tailrace channel, the O&M site, the workers’ camp site, access roads, the power transmission line and temporary areas of construction for site requirements (habitat, workshops, temporary and permanent feeder and access roads, borrow pit sites, disposal areas, etc.). This area includes the project affected villages and to which the land affected by the reservoir and rights-of-way belongs: the villages of Singrobo, Ahouaty, N’dénou, Pacobo and Ahérémou 2, in the two Sub-prefectures of Taabo and Pacobo.

The indirect area of influence comprises the Department of Taabo as well as the Classified Forests of Singrobo and Goudi, the LAMTO Reserve, the upstream area between the Taabo dam and the project site and downstream between the project site and the exit from the Bandama River watershed.

The population identified in the project impact area also comprises households living in the project’s direct right-of-way as well as non-residents who have interests located in that right-of-way (crops, buildings, land, farms, fishing equipment, jobs, etc.)
Figure 3: Plan of Direct and Indirect Areas of Influence

Source: March 2017 ESIA mars 2017
3.2 Physical Environment

Climate: The study area experiences an Attié-type climate, marked by four (4) seasons with significantly different rainfall regimes. Average monthly rainfall is 103.72 mm and the annual amount of rainfall recorded over the observation period (2000 to 2015) varies between 983.8 and 1548.5 mm, with an average of 1235.03 mm. The mean monthly temperature is 28.44 °C and average annual temperature range is low and in the region of 4 °C. Average monthly humidity is 76.41 %. Average monthly evaporation is 70.63 mm (2001-2008).

Air Quality, Noise and Vibrations: The complete absence of polluting industry and vehicle traffic in the study area augurs well for excellent air quality outside windy periods and when cultivated fields are burnt producing smoke. Also, observations made on the basis of the recognition of sources of noise and vibrations, factors affecting the spread of such phenomena and the different ensuing activities, have shown that noise and vibration levels in the study area are low.

Relief and Landscape: The study area is characterized by a succession of very monotonous hills with occasionally higher reliefs. It forms part of the interior plains of Central Côte d’Ivoire, at the foot of the central transition zone between the northern plateaus and the southern plains. The region which is fairly flat has few hills and only has one mountainous area, Mount Taabo. Average altitude is below 600m with north-south facing slopes. The landscape of the study area is characterized by a mosaic of vegetation (gallery forests, secondary forests, shrubby savannah, fallow land and plantations) and a mainly rural type habitat.

Pedology and Geology: the study area is dominated by moderately unsaturated vertisol of the disturbed modal group with indurated granite facies, and iron-rich tropical soils of the reworked group with concretions on impoverished granite-based parent material characterized by a sandy humic soil horizon and clay-rich horizons with frequent concretions. The geotechnical tests carried out by the Building and Public Works Laboratory (LBTP) in the study areas show that it is characterized by the presence of granodiorite, diorite, metavolcanite rock, gabbro and metasiltstones. The main minerals are quartz, plagioclases, biotite and green hronblende. Small quantities of microcline were also observed.

Seismicity: The Ivorian seismic measuring station in LAMTO has only recorded data for the past twenty-six (26) years. It is located about 23 km upstream of the LAMTO dam site and has not witnessed any real earthquake that might confirm any seismic activity in that region. The project is located in an area where the Richter-scale range fluctuates between 3.0 and 3.5. However, to calculate the stability of the structures, the horizontal acceleration induced by the design basis earthquake is 0.1g of the value adopted for the construction of the Kossou dam which was commissioned in 1972.

Sedimentology: sedimentary deposits in the Bandama River have been studied by some researchers particularly in Taabo (upstream from the project site) and in the Bandama estuary (30 km from the mouth). The overall inflow-outflow result is 8812 t. Deposits are strongly influenced by hydrological cycles marked by variable solid and liquid deposits. Deposits calculated on the basis of the length of each season vary between 5 and 15 mm during the small rainy season and between 10 and 30 mm during the main rainy season.

Water Resources: The study area is located in the lower reaches of the Bandama River between the Taabo hydropower dam reservoir and the confluence with the N’Zi. The Bandama basin entirely located on Ivorian territory covers an area of 97 000 km², between 3°50’ and 7° longitude West and 5° and 10°20’ latitude North. It is bordered by the Niger and Volta watersheds to the North, the Boubo, and Agnéby watersheds and the Atlantic Ocean to the south, the Comoé watershed to the East and the Sassandra watershed to the West. The hydrogeology of the study area is characterized
by fractured rock aquifers. There are alterite and fissured aquifers. The weathering areas are thick and may contain significant flows of water which are sometimes tapped by the population by means of wells.

**Water Quality:** Two (2) *in situ* sampling and measuring campaigns were carried out from 14 to 17 January 2016 (in the dry season), and from 1 to 3 July 2016 (in the rainy season), in the seven (7) stations in order to determine the initial state of the different physico-chemical and microbiological parameters of the water and sediments of the section of the Bandama River and its tributaries (from Lake Taabo to Tiassalé) which could be impacted by the project. The main findings are as follows:

- **Main physico-chemical parameters:** Overall, concentrations of oxygen are between 1.1 and 1.4 mgO₂/l. The waters of the Bandama River and its tributaries in the study area may be considered to be of high to medium quality in most of the areas visited on the basis of the guide values. The PH values are between 6.7 and 7.9. The waters of the Bandama River and its tributaries are clear in January and therefore of very high quality. On the other hand, in July, most of the values noted are above 5 NTU reflecting slightly turbid water loaded with deposits;

- **Nutrients:** the nutrient content (NO₃⁻, NO₂⁻, NH₄⁺, PO₄³⁻) of the waters of the Bandama River and its tributaries were on the whole fairly low both in January and in July 2016;

- **Heavy metals:** in general, only traces of metallic elements such as copper, cadmium, manganese, iron, zinc and lead are to be found (between 0.1 and 100 microgrammes per litre) in natural waters. They come from rocks but also sometimes from industrial and economic activities.

- **Pesticides:** Pesticides were found in the water samples in particular substituted urates (linuron, monuron, metoxuron, methabenzthiazuron, chlortoluron and fenuron). No organochlorine pesticides were detected in the water samples from the different stations either in January or July 2016. As in the case of the water samples, the different pesticides were more or less found in the sediment samples. Concentrations of urea-derived herbicides and nitrogen heterocycles detected in the water samples especially in January are above the guide values. It was also confirmed that the water quality was poor in sectors where these molecules were detected. No organophosphate pesticide was found in these waters in July. Edaphic and climatic factors as well as agricultural practices (bad handling of products, of the filling or rinsing of sprayers and/or sprinklers after applying products either by run-off or leaching of soil towards the surface water), as well as accidental spillage make water resources throughout the watershed vulnerable to pesticide pollution;

- **Polycyclic Aromatic Hydrocarbons (PAHs):** For most of the PAHs present in the water samples concentrations exceed accepted international standards. PAHs could result from the incomplete combustion of organic materials of anthropic or natural origin (forest or bush, wood, charcoal fires etc.) exhaust fumes from motor vehicles (road traffic, boats, outboard motors, etc.), dispersed or accidental discharge (leakage of fuel and other oils from motor vehicles).

- **Microbiological Quality:** These findings show that the microbiological quality of water in most of the stations visited does not meet standards accepted by the WHO and EC 2006/2007 Guidelines for Surface Water and Drinking Water.
3.3 **Biological Environment**

3.3.1 **Terrestrial Flora**

**Main Plant Formations**: The study area is located in a forest-savannah transitional area which is favourable to a variety of habitats undoubtedly linked to floristic diversity. The environment’s very high level of anthropization should be noted resulting in significant alteration of the original landscape. The dense semi-deciduous forests on firm land are to be found throughout the study area where it meets the savannah area and are more abundant on the left bank (Ahoutay) of the dam site. The dry forests are extremely parched during the dry season and sometimes appear degraded. The gallery forests run along either the N’Zi, or the Bandama and often small rivers. Forests on the islands offer an open canopy and fairly light undergrowth with fairly closed vegetation in places with hydrophytic vegetation on the forest edges.

**Floristic Wealth**: 359 species have been identified and are distributed among 270 genera and 83 families. Only 13 species were not identified during the dry season. These are mainly grasses including *Mariscus flabelliformis*, *Eleusine indica*, *Pennisetum purpureum*, and *Rottboellia cochinchinensis*. 164 of the species inventoried (i.e. 46% of the species) are trees, shrubs or bushes. There are few grass species in the LAMTO reserve while vinelike species only represent 29% of the total number. The most numerous species (73%) are those that are found naturally in the Guineo-Congolian region (GC). These are followed by the GC-SZ species (transitional species between the Guineo-Congolian and Sudano-Zambebian regions).

**Special Status Terrestrial Floristic Species**: Species with special status are those which are threatened with extinction according to the IUCN red list or threatened according to the local Aké-Assi” status or finally those which different endemic levels. The inventories have identified twenty (20) threatened species. On the IUCN red list, seventeen (17) plant species were identified belonging to the following categories: (i) Vulnerable (VU), with 4 species; near threatened (NT or LR/nt), with 2 species; (ii) least concerned (LC), for 10 species.

Four (4) species are on the Aké-Assi list (1998). These are *Milicia excelsa*, *Milicia regia* (which is also on the IUCN red list), *Uvaria ovata* and *Psilanthus mannii*.

3.3.2 **Aquatic Flora**

No phytogeographical study has been conducted on populations of aquatic plants in the Bandama basin. However, aerial observations made over most of this watershed have produced some come comments on the populations of aquatic plants of the Bandama watershed. In the calm areas of the water courses, some species grow sparsely: *Pistia stratiotes*, *Ceratophyllum demersum* (Upper and Lower Bandama, Lower N’Zi), *Vallisneria sp.* (Lower Bandama) and some *Potamogeton* (Upper Basin of the Bandama and its tributaries). The small reservoirs are often invaded by *Pistia stratiotes*, combined with vast populations of *Nymphaea micrantha* which are substituted by *Ipomoea aquatica* on the edges of the banks. In flooded forest areas *Lemnaceae* and *Alismataceae* grow abundantly. Finally in the large reservoirs significant populations of *Pistia stratiotes* are observed often located near the banks. *Eichhornia crassipes* has never been observed to date in the Bandama basin.

3.3.3 **Terrestrial Fauna**
Wildlife inventories were conducted from 25 January to 3 February 2016 and from 28 June to 7 July 2016. A total of 103 sampling points were identified on 13 transects spread over the right and left bank of the Bandama River in the study area.

**Amphibians** are represented by seven (7) species distributed among five (5) genera and five (5) families in the different habitats sampled and the most common habitats are in forest areas. These are *Amietophrynus regularus*, *Hoplobatrachus occipitalis*, *Hyperolius fusciventris*, *Hyperolius guttulatus*, *Phrynobatrachus calcaratus*, *Phrynobatrachus latifons* and *Ptychadena pumilio*. The **reptile** community is dominated by four (4) species belonging to four (4) genera and four (4) families: *Agama agama*, *Hemidactylus* sp., *Varanus* sp. and *Crocodylus suchus*.

**Concerning birds**, the study has identified 244 bird species distributed among 149 genera and 54 families, including seven (7) species, i.e. 3% of the avian fauna population have aroused global interest. These are: (i) two (2) species in the vulnerable category (VU): the grey parrot *Psittacus erithacus* (erithacus) timneh and the yellow-bearded bulbul *Criniger olivaceus*; (ii) four (4) species in the near-threatened category (NT): the green-tailed bristlebill *Bleda eximius*, black-capped rufous warbler, *Bathmocercus cerviniventris*, the red-headed babbler *Illadopsis rufescens* and the bronzetailed starling *Lamprotornis cupreocauda*; and (iii) one (1) species in the data deficient category (DD): the yellow-footed honey guide, *Meligmonon eisenrauti*.

The **main mammals** observed or/and reported on the site and its environs include the following 15 taxa: the hare (*Lepus capensis*), abundant on the site; the wild rabbit (*Oryctolagus cuniculus*), rare on the site; the barbary squirrel (*Atlantoxerus getulus*), rare in the study sector; the North African gerbil (*Gerbillus campestris*); the North African sengi (*Elephantulus rozeti*), micromammal endemic in North Africa; fat sand rat (*Psammomys obesus*), abundant gerbil; wood mouse (*Apodemus sylvaticus*); grey mouse (*Mus musculus*); great jerboa (*Jaculus orientalis*); weasel (*Mustela nivalis*), very rare mustelidae on the site; African kaffir cat (*Felis libyca*), very rare; Egyptian mongoose (*Herpestes ichneumon*); slender mongoose (*Herpestes sanguineus*), very rare on the site; genet (*Genetta genetta*), very rare on the site. All these species benefit from national regulations (considered as threatened) specific to the Protected Areas Master Plan. Only the Algerian hedgehog (*Erinaceus algerius*) is listed on the IUCN red list in the VU category: vulnerable. The other species are of least concern.

### 4.3.4 Aquatic Fauna

The characterization of ichthyofauna takes place in the lower reaches of the water course, especially in the part of the river located between the Taabo dam, upstream, and the town of Tiassalé, downstream. The inventory was conducted over two seasons with one reconnaissance mission fielded from 14 to 16 January 2016 and data collection campaigns from 24 to 28 January 2016, then from 1 to 3 July 2016 on eight (8) sampling sites. The cumulative results of the inventories conducted during the two campaigns of January and July 2016 (dry season and rainy season) reported 47 taxa identified in the part of the Bandama River affected by the dam project. Fish species mainly in the middle reaches of the river belong to 30 genera distributed among 18 families. The richest families are the Cichlidae (11 species), the Mormyridae (7 species) and the Alestidae (5 species). The spatial distribution of this biodiversity shows that the future reservoir area (Singrobo-Ahouaty) has the greatest specific wealth with 40 taxa and the downstream area the lowest (30 taxa). The two macrocrustaceans belong to the Macrobrachium genera (river shrimps or crayfish) and Atya. The macrocrustaceans of the Machrobrachium genus (river shrimps or crayfish) observed in the study area are amphidromous species whose biological cycles occur in two different environments (Lagoon and River). These estuary species move up the Bandama Rivers from the Grand-Lahou lagoon to mature and then redescend towards the lagoon (brackish environment) for their larval growth.
The inventory of biological resources in the project area identified seven (7) vulnerable species: (i) *Milicia excelsa*, *Milicia regia* (IUCN red list), *Uvaria ovata* and *Psilanthus mannii* on the Aké-Assi list of vulnerable plant species; (ii) the grey parrot *Psittacus (erithacus) timneh* and the yellow-bearded bulbul - *Crimiger olivaceus*; (iii) *Hippopotamus amphibious* is the only large mammal listed as a vulnerable species (VU).

None of the 52 ichthyological and carcinological species inventoried in the study are critically endangered or nearing extinction.

**Key Habitats:** While hosting species of interest in terms of biodiversity conservation, the studies have not confirmed any significant loss of habitats considered to be critical according to the definition of the IFC’s performance standard 6 which is the equivalent of AfDB’s OS-3. The different habitats inventoried in the project area are greatly modified and have no critical importance for endemic, vulnerable or threatened species identified in the project area. Moreover, it is highly unlikely that the project will impact on major concentrations of migratory birds and/or unique species associated with key evolutive processes that could trigger a critical habitat. These points will be confirmed by a supplementary international independent biodiversity assessment and additional measures will be proposed in a Biodiversity Action Plan.

**Ecosystem Services:** The ecosystem services identified in the project area are chiefly of a supply and cultural nature: (i) plants and plant species are used for food, in traditional medicine, crafts,. for cultural purposes, fuel wood and as fodder; (ii) fishing for fish and crayfish: this activity is described in detail in the socio-economic study.

While villages generally have drinking water points, the population uses water from rivers, streams and marshes for agriculture and some domestic needs and as drinking or bathing water.

### 3.4 Socioeconomic Environment

The socioeconomic surveys conducted in January and November 2016 covered ten (10) villages five (5) of which will have part of their land directly impacted by the project (Ahouaty and N’Dénou on the right bank and Singrobo, Pacobo and Ahérémou 2 on the left bank).

**Administrative and Geographical Situation:** Taabo Department is bordered by the Departments of Tiassalé and Divo to the South, Agboville to the East, Toumodi and Djèkanou to the North, and Oumé to the West. In addition to the city or town, the Department has a total of nineteen (19) villages including five (05) (Taabo- village, N’Dénou, Kotiéssou, Ahondo and Kokotikouamékro) that form part of the municipality space, thirteen (13) in Taabo sub-prefecture and six (06) in Pacobo Sub-Prefecture. Five (05) villages will be directly affected by the project since they supply the sites for the construction of the different structures: Singrobo and Pacobo, in Pacobo sub-prefecture, and Ahérémou 2, N’Dénou and Ahouaty, in Taabo sub-prefecture.

**Demography and socioeconomic profile:** Overall, Taabo Department has, according to the 2014 GPHC a population of 56,422 people, 41,912 thousand of whom live in Taabo sub-prefecture and 14,510 in Pacobo sub-prefecture. This population is broken down into 9,808 households with an average size of 5.8 people per household. The autochthone population¹ of Taabo is composed of Souamelin in the North-West, N’Gbana, Ahétou and Walébo, to the East and Didia to the South-West. The ‘allochthone’ communities are composed of Ivorian nationals who are not born in Taabo, the Department where the project will be implemented. Belonging to different ethnic groups in the country, they mainly comprise Kwa Akan (Baoulé, Agni, Abron), Lagoon Kwa (Abbey, Akyé), Gur or Voltaics (Sénoufo), Mandé (Malinké, Yacouba, Gouro) and Krou (Bété, Guéré). The

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¹ The term ‘autochthone’ as used in Côte d’Ivoire refers in general to a person who is born either in the village or in its immediate vicinity.
allogenic or foreign communities mainly citizens of countries in the West African region (Burkinabés, Malians, Togolese, Nigerians, Nigeriens, Mauritanians and Senegalese), but also Europeans.

The description of the socio-economic profile of households living in, or with interests in the project villages, is based on the findings of the survey conducted on a sample of 453 households representing a little over 22% of all 2094 households in the 5 villages, instead of the 20% initially planned. The average size of households in the surveyed localities which is 5.9 exceeds those recorded at Departmental (5.8 people/household), regional (5.1/people/household) and national (5.4 people/household) levels. The estimated total population of the households surveyed in the five villages impacted by the project comprises 52% males and 48% females i.e. a ratio of 93 females to 100 males. This population mainly comprises under-15 children (36%) and youths in the 15 to 34 year old age group (33%).

**Land Tenure, Gender and Vulnerability**

Land tenure is governed either by customary law or by modern law. However, it must be stressed that customary law prevails on all rural land. This law sets the modalities for access to, and use of land by autochthone and foreign communities (autochthones and allogens). There are four (4) main types of land acquisition: (i) acquisition following a few years work for the land owner; (ii) free transfer upon request subject to a gift or sharing of production; - plot rental (more frequent); and (iii) purchase of land.

While nothing prohibits women from inheriting or managing land, in practice, it is rare to find women recognized as land owners. Social groups appear to hesitate between two contradictory positions: (i) not to entrust land to women for they will soon become spouses and leave for other families (which would result in a loss of family property); (ii) a willingness to grant women as a sister or daughter the status of full member of the lineal descendant group from which they originate, especially in the case of the matrilineal society.

While commodification has facilitated women’s access to land, in the vast majority of cases it is their husband or brother who manages the land. These elements must be taken into account in this project to ensure that women are not excluded from access to the compensation earmarked for the loss of assets or farms. Single women and widows are particularly vulnerable.

**Economic Activities**

- **Agriculture**: the great richness of humic soil horizons is a valuable asset for the development of different crops. Thus, in Taabo, perennial crops are grown (coffee, cocoa, cashews, cotton, oil palms and rubber, etc.), as well as food crops (rainfed rice, groundnuts, cassava, yams, and bananas and market garden crops (aubergines, okra, tomatoes, chili peppers, lettuce, cucumbers, cabbage, etc.)

- **Fishing and Fishery Products**: fishing is carried out in the river and in the hydropower dam lake. The dam impoundment is mainly fished by foreign fishermen, Malian bozos, since autochthones are only occasional fishers. Two types of women sell fish: (i) retailers who purchase small quantities and resell them in the village (fresh or smoked depending on available financial resources) but also in some cases at the road side (only smoked fish) [especially for Singrobo women]; (ii) wholesalers who buy in large quantities and export outside the zone to the major towns and cities. Fish may be sold fresh (higher added value but requiring significant social and financial capital), frozen or smoked. Some wholesalers live outside the zone but travel in during the main crayfish season;
Livestock and Livestock Products: This is a little developed sector of activity in the Department which is practiced in a very traditional manner. However in all the villages there is small livestock potential for cattle, sheep, goats, pigs and poultry, which is being modernized with assistance from ANADER;

Access to basic infrastructure and social services

Health: Taabo Department has several health facilities, namely: one (1) general hospital, ten (10) health centres, one (1) private pharmacy and private infirmaries and medical stores. Helminths such as intestinal bilharzia, urinary bilharzia and ankylostomiasis exist but in fairly small proportions of 8.8 %, 7.8 % and 2.7 % respectively. The study area is not a high-risk area for human trypanosomiasis and onchocerciasis but would require increased monitoring due to highly pronounced biotope degradataion. Malaria and HIV/AIDS remain major health problems with respective prevalence rates of 33-75 % and 11.4 %.

Education: Taabo Department has a primary school inspectorate which manages 50 public establishment comprising 10 pre-schools and 40 primary schools. Two (2) private primary schools also provide training for children in the Department. In Taabo village almost the entire village is electrified. However with urbanization they are all applying to expand their respective networks.

Drinking Water: Taabo town has two (2) water towers each with a capacity of 500 m3 supplied by a treatment plant that can treat 310 m3/day. The villages generally receive wells equipped with human-powered pumps, with the exception of the modern villages of Taabo-village and Ahondo which are supplied with water from the network, backed up by boreholes. The Department’s villages do not have a stormwater drainage network. The sanitation system is usually composed of latrines and soak pits which are often faulty.

Cultural Heritage

In order to anticipate the management of possible cultural heritage site protection problems, an inventory of cultural assets (archeological, especially existing or virtual), identification of possible archeological resources (and possibly the organic remains accompanying them) and mapping of all these complex elements were carried out in the area. The distribution by bank gives the following results:

Left Bank: (i) two sacred sites in Ahérémou 2: Logbodjibo and the sacred forest of Ahérémou; (ii) 4 sacred sites in: Bandama, Essoué Tanou, Bla N’goulan and Pacobo cemetery; (iii) 8 sanctuaries inventoried in Singrobo: Kplaliké, Adjo, Oka blé, Bandama, N’da blassou, Kpoubounou, Appi fièbo and the cemetery;

Right Bank: two sanctuaries and two cemeteries (N’didikobo, Mlanguisso, Didissou and Ehimouzoué) in N’dénou. Three sanctuaries in Ahouaty: Bonvo, the cemetery of the former village and the existing village cemetery.

The material gathered also reveals the existence of lithic industries (Paleolithic and Neolithic) and iron production in the region of Taabo.

4 Alternative Project Solutions

4.1 Situation without Project Implementation
The alternative to not implementing the Singrobo-Ahouaty Hydropower Development Project would remove all the positive impacts and not offsettable negative impacts identified in this ESIA. In environmental terms, the project’s main negative impacts which would be avoided are loss of habitat and plant species and terrestrial animals, alteration of river morphology, hydrology and hydraulics, modification of habitats and aquatic populations. In socio-economic terms, the ‘without project implementation’ option will mainly result in a loss of earnings for the population, the Department and the country. The ‘with project implementation’ option will, among others, foster the enhancement of the local economy (with the creation of many direct and indirect jobs), improvement of access to certain riparian villages (specifically, the villages of Ahouaty, Amani-Ménou, Sokrogbó and N’Dénou), economic development opportunities (with the development of the fishing sector) and a contribution to the closing of the country’s electric power gap. These gains should normally, to some extent, compensate for the loss of land, crops, economic activities, buildings, equipment and housing as well as population displacement.

4.2 Alternative Project Sites

For many years sites have been studied for the construction of a dam on the Bandama River. Different technical, financial, environmental and social criteria resulted in the selection of the Singrobo-Ahouaty site. In addition to the advantages of accessibility and connection to the power grid, this site basically has the least impact on the physical resettlement of the local populations and does not flood forests with a high ecological value.

4.3 Design Alternatives

The PD reviewed the main categories of optimization, in particular, installed capacity by considering configurations rising gradually from 22MW to 50MW. The following characteristics were agreed upon in the PD. Following the signing on 18 December 2013 of a concession agreement between the central government of Côte d’Ivoire and IHE, IHE conducted the necessary hydrological, topographical, geotechnical studies required to optimize the design of the hydropower facility and define a Detailed Design (APD).

The dam characteristics according to the DD were as follows:

- Design flow: 203 m³/s ;
- Installed capacity: 44 MW via two vertical Kaplan turbines each with a capacity of 22MW;
- Design flood discharge rate: 2700 m³/s ;
- Average annual generation potential: 212 GWh ;
- Normal level of reservoir: 65,5 m ;
- Available gross head: 27 m ;
- Dam Type: rock-filled with clay core or with the use of a geomembrane.

Table 1
Summary of the Analysis of E&S Optimization Alternatives and Options
<table>
<thead>
<tr>
<th>Optimization Parameters</th>
<th>Singrobo-Ahouaty</th>
<th>Tiassalé</th>
<th>Daboïtié</th>
<th>Kokumbo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Upstream from the Bandama-Nzi confluence and downstream from the Taabo dam</td>
<td>Last site identified on the Bandama</td>
<td>Located upstream from Tiassalé at the confluence of the Bandama and NZI</td>
<td>Immediately upstream from the Taabo dam</td>
</tr>
<tr>
<td><strong>Technical characteristics</strong></td>
<td>Installed capacity 44 mW Generation potential 217 GWh</td>
<td>Installed capacity 36 MW High average cost of electricity</td>
<td>Installed capacity: 91 MW Generation potential: 315 GWh</td>
<td>Installed capacity 78 MW</td>
</tr>
<tr>
<td><strong>Minimize the reservoir area</strong></td>
<td>Flooded area: 19 Km²</td>
<td>Flooded area: 7 km²</td>
<td>Flooded area: 115 Km²</td>
<td>Flooded area: 300 Km²</td>
</tr>
<tr>
<td><strong>Avoid physical involuntary resettlement</strong></td>
<td>Very little physical resettlement (19 people)</td>
<td>Located in Tiassalé town centre: Part of Tiassalé flooded</td>
<td>Several villages will be submerged</td>
<td>Several villages will be submerged</td>
</tr>
<tr>
<td><strong>Minimize the flooding of forests</strong></td>
<td>Neighbouring classified forests will not be flooded</td>
<td>Part of the neighbouring forests will be flooded</td>
<td>Forests flooded along the river up to 1 km from the Singrobo Ahouaty dam</td>
<td>A vast area of forests flooded by water when the dam is filled</td>
</tr>
<tr>
<td><strong>Avoid recognized and protected cultural areas</strong></td>
<td>The area contains cultural sites recognized only by the local populations. Following consultations with the population some sites may be displaced or special or special ceremonies held to obtain forgiveness</td>
<td>No protected areas of high cultural value</td>
<td>No protected areas of high cultural value</td>
<td>No protected areas of high cultural value</td>
</tr>
</tbody>
</table>
| **Environmental and social challenges** | Very little physical resettlement. | Part of the town flooded, major social challenges. | • High environmental and social challenges and costs  
• Flooded villages  
• Large areas of industrial banana plantations flooded  
• Large forest areas flooded | High environmental costs especially for the physical resettlement of the population |
| **Other criteria** | • Ideal site access conditions | Discontinuation of study since it is not financially viable and for | Discontinuation of study since it is not financially viable and for the involuntary physical | Discontinuation of study since it is not financially viable and for the involuntary physical |
5. Main Potential Impacts

5.1 Summary of positive impacts during the construction phase

**Economy and Employment:** Jobs (mainly unskilled or low-skilled), estimated at around 500 (workers, labourers, electricians, technicians, engineers and project managers, etc.) positions to be filled, will be created for the populations of the villages and/or localities in Taabo Department. In addition to these direct jobs, the site activities will create significant financial flows through the purchase of local products. Part of the works could also be outsourced to local firms, in particular, the construction of access roads to the O&M camp site, the workers’ campsite, etc.

5.2 Summary of Positive Impacts during Operational Phase

**Contribution to the Closing of the Country’s Electric Power Gap**

In its operational phase (44 MW), the project will to some extent contribute to the closing of Côte d’Ivoire’s electricity gap

**Reduction of greenhouse gas emissions:** The project impacts on climate and air quality in the operational phase relate to the avoidance of carbon emissions which would have been necessary to produce the same quantity of electricity by a hybrid or open cycle (gas) thermal power plant (gas). On the basis of 0.65 t CO2/MWh of electricity and a reservoir emission factor of 90g CO2 eq per kwh, the Singrobo-Ahouaty Hydropower Development Project will result in an annual reduction of 109,561 t eq CO2.

**Creation of new habitats for avian fauna:** The presence of the reservoir will create new original habitats. A mosaic of environments composed of open water, banks edged with low vegetation, erosion area, riparian vegetation will become established that will foster the feeding of, and create a refuge for some species such as the little egret *Egretta garzetta*, the grey heron *Ardea cinerea* and Allen’s Gallinule, *Porphyrio alleni* on the banks and possible small islands in the dam. The morphoedaphic index applied to the future reservoir at its planned normal operating level (18.8 km²) results in minimum fish farming productivity of about 100 kg/ha/yr, i.e. production of about 190 tonnes/year.

**Creation of fisheries potential in the reservoir.** Fish farming yields in the future reservoir will be significantly higher than current production from the corresponding water course section. It will more than offset the loss of production in the by-passed section.

**Opening up of riparian villages:** The existence of the dam and its infrastructure such as the embankment and its access roads will facilitate the opening up of the riparian villages of Ahouaty, Amani-Ménou, Sokrogo and N’Dénou. This infrastructure will facilitate rapid access to the North motorway about 3km from the left bank of the river for the movement of people and goods.
**Economic Development Opportunities:** the expected local economic spin-off from the dam’s operation will concern the presence of the developer’s operational staff, collective facilities (market, school, hospital), in terms of the development of the fisheries sector. The fish wholesaler women who market fish will see their activity grow and become better organized as a result of the new reservoir and establishment of a Fisheries Development Plan.

### 5.3. Summary of Main Negative Impacts during the Construction Phases

**Land Acquisition:** The project affects a total of 730 households including 3 legal entities (industrial companies) and the State which owns land assets in the right-of-way. 2 of the 730 affected households are physically displaced. These are the 2 households that have their main residence in the project right-of-way. The other PAP are concerned by economic displacements. The total number of project affected people is 43111 distributed as follows:

- 728 economically displaced people comprising at least 5.9 people i.e. a total of 4296 people;
- 2 physically displaced people comprising 15 people.

Agricultural land affected is largely under customary law or on a long-term lease from the State. In all, 1362.2 ha of agricultural land will be affected by the project. Further details are provided in the RAP.

**Alteration of Air Quality, Acoustic Conditions and the Landscape.** The planned site activities are expected to be implemented over a 39-month period and will most probably affect air quality, acoustic conditions and the landscape in the project area. This will result in the emission of particulate matter (dust) and gas fumes (NOx, SO2, CO), mainly arising from the works on the site areas, operation of the borrow and disposal areas and the movement of the different machines. The clearing of the reservoir right-of-way (1,880 ha, with an NRL of 65.5 m) will affect the landscape. The construction works will create sound nuisance for the site workers, local residents and animals in the works area. However, since the closest dwellings are about 500 m from the construction sites of the workers’ campsite (at the level of Singrobo village on the left bank) and the O&M campsite (at the level of Ahouaty village on the right bank), and the construction sites for the dam and hydropower structures are located about 3 km from these villages, acoustic nuisances should be limited in that area.

**Risks of Soil Degradation and River Water Pollution:** The dam construction site and related infrastructure are likely to generate significant organic, inorganic and bacteriological pollution of the river water. The main risk incurred will be an increase in the load of suspended solids (SS) immediately downstream from the dam, whose possible origins will be run-off in the rainy season onto to the earth fill areas in the major bed during construction of the structures and facilities and sediment suspension in the minor bed.

**Risks of pressure on the protected areas and loss of habitats and terrestrial species:** the Goudi classified forest and LAMTO reserve located close to the Singrobo-Ahouaty Hydropower Development Project site will be subjected to pressure connected to the project construction works. The establishment of the sites (mainly the dam site), then the filling of the reservoir will lead to deforestation and/or the submersion of rights-of-way for the dam impoundment, the structures (embankment, spillway, tailrace channel, hydropower plant) and facilities (O&M site, workers campsite and living quarters). This implies that habitats and populations of plant species will be destroyed during the project’s implementation. However, no habitat inventoried in this assessment has protected status, either for the migration of animal species, or the nesting of birds. The only
vulnerable mammal entered in the IUCN list is the amphibious hippopotamus (*Hippopotamus amphibious*) which will be only slightly impacted.

**Risks to health and safety of workers and local communities:** The site activities will result in alterations to the quality and structure of some components of the physical environment: air, soil and water. Alongside these impacts, the site activities that will be carried out during the entire construction phase will also create nuisances and risks for site workers, local residents and human activities.

**Project impacts on aquatic fauna:** The dam’s impact on the 3 types of lagoon fish will be negligible since these species, while migratory and diadromous, spend their life cycle including reproduction in the estuaries and lagoons. The only probable impact in this case will be a reduction of their distribution area (longitudinal) with the advent of the dam. Such an impact does not justify a fishway, since these fish will spend their life cycle even in the presence of the Singrobo-Ahouaty dam. Macrouran populations have a diadromous life cycle characterized by downstream migrations (migrations carried out by newly emerged larvae that are carried by the current of the estuaries) and upstream migrations (upstream migrations of juveniles that show positive rheotactism). These shrimp populations are sensitive to hydraulic development works across the water course. Wherever they constitute uncrossable barriers, the life cycle is interrupted and these species will tend to disappear upstream from the structures. It is, therefore, advisable to identify areas with shrimp production potential downstream from the Singrobo-Ahouaty dam (for example, in the Tiassalé area) and to make them areas for regular crayfish monitoring.

**Modification of Ecosystem Supply Services:** Ecosystem services provided by the Bandama’s riparian vegetation in particular for the gathering of fuelwood as well as non-wood forest products (fruit, medicinal plants etc.) will be affected by the Project.

**Damage to archaeological and/or cultural assets:** the site activities are likely to damage archaeological and/or cultural assets identified at this stage (intangible and tangible cultural heritage) not identified and which have not been discovered by the archeological survey carried out under this study. The tangible assets have been inventoried (see description of the environment) and will be displaced. Intangible assets mainly concern spirit dwelling places and tombs on the edges of the river. These losses require the holding of ceremonies prior to the dam construction works, the costs of which were calculated in consultation with the villages.

5.4. **Summary of Main Negative Impacts during the Operational Phase**

**Modifications to the river’s morphology upstream from the dam:** Modifications to the river’s morphology upstream from the dam will result in the replacement of a river regime by a lake regime and the creation of a permanent impoundment whose level will be constant for most of the time. Upstream from the dam, the river environment will be replaced by a lake environment over about ten kilometres. The existing morphological characteristics of the river (meanders, stretches of rapids, river arms forming islands) will disappear under the impoundment water. The same will apply to riparian areas regularly submerged by annual floodwaters which constitute humid areas and flood-plains.

**Hydrological and hydraulic modifications to the river in the by-passed reach:** The River’s hydrology and hydraulics in the by-passed reach will also be modified. An instream flow is planned under the project in order to ensure biological continuity in this section. It should be noted that the other dams in Côte d’Ivoire have not provided for any instream flow and consequently the Singrobo-Ahouaty will be the first dam in Côte d’Ivoire to have provided an instream flow of the river in the parched section downstream from the dam.
Morphological modifications to the river bed in the by-passed reach: The morphological modifications to the river in the by-passed section are due to the project’s direct impacts and in particular the creation of the reservoir. The consequences will be a highly significant change in the morphology of the minor bed. The river’s appearance, in particular, the size of the river’s wet bed and the river’s flow facies will be modified.

Hydrological and hydraulic modifications to the river downstream from the dam: since the Singrobo-Ahouaty hydropower facilities are virtually run-of-river with a very short staying time of water (only a few hours), is unlikely to significantly modify the river’s hydrological regime downstream of the water release point; unless the Taabo dam generators are stopped, a situation that would result in a longer emptying time (2-5 days).

Trend of the physico-chemical quality of the reservoir’s water: the shallowness of the reservoir (5 m, on average and 15 to 20 m close to the structures) and its rapid replenishment (just a few hours) are conditions that are not conducive to stratification of the water mass. The latter should be homogeneous, in particular for the parameters such as temperature and dissolved oxygen content. It will not be necessary to expect the formation of a deoxygenated bottom layer, loaded with methane and other reduced compounds unsuitable for aquatic life.

Risks of colonization of the reservoir by aquatic plants: several types of invasive aquatic plants (IAP) are present in the watershed: Pistia stratiotes, Ceratophyllum demersum, Vallisneria sp., Potamogeton. It was, however, observed that the reservoirs created at watershed level are often seriously invaded by Pistia stratiotes, combined with vast populations of Nymphaea micrantha which are substituted by Ipomoea aquatica on the edges of the banks. In view of the speed at which the water mass is renewed this does not create favourable conditions for the invasion of the entire water body.

Modification of habitats and aquatic populations at reservoir level: In the future submerged zone, the existing flow facies (succession of rapids and slower and deeper areas) will disappear and be replaced by a lake-type habitat. The original fish-farming population of the sector will be modified. Rheophilic species and species feeding on the periphyton that cover the rocks (Amphilius sp., Labeo sp.) may be expected to disappear at the same time as a relative increase of species adapted to slow flowing water such as tilapia or even microphages that feed on phytoplankton.

Modification of habitats and aquatic populations in the by-passed reach: The low run-off even drying up of the by-passed sector will result in a significant loss of fish-farming habitats due to the very significant reduction in the area of the wet bed, the average depth, and quality of the environment. On this sector there is likely to be a sharp reduction in the biomass and specific diversity. Some species with high commercial value such as the threadfin Lates niloticus could disappear given the absence of a large water mass. The Macrobrachium in their migration up the water course with a peak in August will probably accumulate at the foot of the dam which will create an uncrossable obstacle to their migration.
Loss of Income

In addition to the impact on land and crops, the project will result in loss of earnings from economic activities such as fishing and fish trading as well as livestock activities and also jobs for agricultural workers and farm labourers as well as fishermen’s and fish traders’ helpers. The study area, more specifically Singrobo, Pacobo, N’Dênou and Ahouaty have abundant crayfish stocks. This is mainly due to the fact that these macrocrustaceans in their migration from the lagoons located in the lower reaches of the river reproduce there specifically. Thus with the presence of the dam, crayfish will disappear in the area and will be found further downstream as was the case when the Taabo dam was constructed upstream.

Risks to the public safety of local communities: operation of the hydropower dam will cause flow variations which could become dangerous for the populations of riparian villages and downstream from the spillway during release operations (floodwaters). More specifically, this will concern the section of river between the dam spillway and the water release point in the normal river course during water release operations.

Risks to the public health of the riparian communities: the presence of the reservoir and the size of its banks will create risks of waterborne diseases such as malaria and bilharzia. The risk is real insofar as the sanitary conditions at the edge of river are conducive.

Risks linked to the operation of the dam (dam failure and flooding): An assessment of the risk of dam failure on the basis of a mathematical model was not yet ready when this ESIA was being conducted. This assessment will concern the total and immediate failure of the Singrobo-Ahouaty dam. The model will have to provide simulations on the damping of the wedge of water shifting rapidly from its thickness at dam level to a much shallower level further downstream following a dam failure. The model will consider the extreme conditions of dam failure and will identify damage that might be caused by the failure to its construction, infrastructure and fields downstream from the dam. This assessment must be finalized no later than six months before the filling of the dam.

5.5. Cumulative Impacts

Hydrological and hydraulic modifications in the river’s lower course: The project will be implemented in an environment where similar facilities have been established for several decades, in particular, the hydropower dams of Kossou (commissioned in 1972) and Taabo (commissioned in 1979). Apart from the economic impacts of these two (02) facilities for Côte d’Ivoire’s central government, these structures have impacts on surface water resources in particular, modifications to the hydrological regime of the water course. Following construction of the Singrobo-Ahouaty hydro-power dam, these impacts should be strengthened, which will further disturb the hydrological functioning of the river.

Deterioration of water quality: It should be noted that the study on the aquatic environment (Annex II) revealed that the water course is slightly turpid and loaded with SS at the level of the Taabo dam reservoir (upstream) and the N’Zi (downstream). This situation is mainly due to the use of fertilizers and pesticides, and domestic discharges at the watershed level, which are then washed towards the water course.

Degradation of Goudi classified forest: The study on flora and the study on fauna showed that the Goudi classified forest (unlike the LAMTO reserve) exists in name only since it has already been severely anthropized with the presence of several plantations and areas of fallow land within it. This degradation could be exacerbated by the project with the possible disappearance of this
protected area due to the presence of personnel of the contractor (during the works phase) and of the dam operator (during the operational phase).

**Impacts on the LAMTO Reserve:** The LAMTO Reserve is characterized by a mosaic of 2500 ha of savannah and gallery forests containing several species of birds (like the white-necked rockfowl, included in the IUCN red list), mammals, amphibians, reptiles and invertebrates (Lepidoptera). Since the normal operating reservoir level of the future Singrobo-Ahouaty dam will be 65.5 m (lower than that of the Taabo dam), it can be confirmed that the project’s implementation will have no additional impact on the biodiversity (flora and fauna) of this reserve. Furthermore, the two dams will function in perfect synergy while maintaining this NOL difference so as to protect their different structures in order to ensure the sustainability of their respective power generation levels.

**Increase in land disputes:** the Region of Agneby-Tiassa, like all the country’s regions is under great land pressure. The displacement and resettlement of PAPs will, therefore, exacerbate cases of land disputes. Appeal, redress and grievance management mechanisms will be proposed in order to ensure transparent management of claims that could be received by the project.

**Increase in waterborne diseases:** The high prevalence in the study area of water-borne diseases, in particular malaria, is due to the existence of the Taabo dam upstream. Following the commissioning of the Singrobo-Ahouaty dam, this prevalence rate will increase, unless measures are taken to reduce it.

### 6. Mitigation/Enhancement Measures and Supplementary Initiatives

#### 6.1 Normative and Administrative Measures

It is necessary to ensure the project’s compliance with applicable regulations, administrative and contractual requirements, in particular:

- **Compliance with environmental and social regulations:** The project must ensure compliance with existing national environmental and social regulations as well as those of AfDB in both the construction and operational phases. Also, a list of authorizations and permits must be produced and the engineering consultant will have to ensure that the developer, contractor and its sub-contractors also comply with them. The submission of the ESIA certificate of environmental compliance to the Board of Directors is one of the conditions of the environmental and social action plan.

- **IHE Environmental and Social Management System (ESMS):** Its objective is to prevent and minimize negative environmental and social impacts and to enhance the positive impact of the project implemented by the sponsor (IHE). It will provide the framework and guidelines guaranteeing that the latter has a strong commitment and the capacity to comply with national legislation and donors’ policies and standards in force in its selection, approval, investment and monitoring operations relating to the Singrobo-Ahouaty Hydropower Development Project. IHE has planned the establishment of this ESMS on the basis of the ISO 14001 reference in addition to attestations of safety and social accountability.

- **IHE’s Hygiene, Health, Safety and Environment Plan:** IHE will prepare a specific HHSE Plan for its activity and the project in accordance with IFC performance standards, the World Bank’s environmental and safety guidelines and the appropriate national requirements.
• Fair, equitable and prior compensation: the compensation process will be launched prior to the start-up of works for each section concerned. Evidence of such compensation shall be submitted to AfDB.

• Commitments and deliverables of each contractor: the contractor shall prepare and have validated by the project manager, implement and update a Site Environmental and Social Management Plan (SESMP). This SESMP will, in particular, define: (i) the planning framework: risk identification and assessment, applicable legal and regulatory framework, objectives and targets, selected performance indicators; (ii) the SESMP implementation framework: organization and distribution of responsibilities, sensitization and training programmes, communications process, documentation process and documents control, operations control and emergency response procedures; (iii) control and corrective actions: monitoring of sites and activities, detection, correction and prevention of non-conformities, data management, audit management; and (iv) a procedure for updating and review by government services. As a minimum, the SESMP shall indicate:
  o The contractor’s environmental and social management system:
  o The specific management plans: (i) the contractors Hygiene-Safety-Environment Plan; (ii) excess soil management plan; (iii) hazardous products management plan; (iv) Management Plan relating to accidental spillage or any other major incident; (v) erosion and sedimentation management plan; (vi) Revegetation and Site Rehabilitation Management Plan; (vii) Living Quarters Management Plan; (viii) Public Health Management Plan; (ix) Air Emissions, Dust and Noise Management Plan; (x) Road Traffic and Access Management Plan; (xi) Cultural Resources Management Plan; (xii) Borrow Zone Management Plan; (xiii) Environmental and Social Training Management Plan; (xiv) Water Quality Management Plan; (xv) Waste Management Plan; (xvi) Human resource policies, recruitment policy, accommodation programme and living quarters management, dismissal plan, etc. and site rehabilitation plan.

6.2 Summary of Specific Measures and Supplementary Initiatives

Construction Phase

Land Acquisition: The RAP’s implementation will mitigate and provide compensation for impacts relating to loss of land. The estimated cost of implementing the RAP is CFAF 9.6 billion comprising: (i) CFAF 8 billion for compensation; (ii) 0.3 billion for the restoration of livelihoods; (iii) CFAF 0.05 billion for assistance to vulnerable people; (iv) 0.8 for project management support. Monitoring the RAP’s implementation and the functioning of the disputes settlement committee will mitigate expropriation-related impacts. Since the submission of proof of compensation is a condition precedent to works start-up on the sections concerned or filling of the reservoir, it is important to ensure optimal RAP implementation.

Air, Noise and Landscape-related Measures: The Contractor will be responsible for the maintenance and inspection of vehicles for exhaust emissions and must comply with good site management practices (speed limits, transportation and storage of materials, etc.). A deforestation plan will be prepared and applied in order to enhance the wood as much as possible and limit smoke emissions. This deforestation plan should take into account the possibility of supplying wood from felled trees to the population. The use of explosives or noisy machinery will be prohibited between 6 p.m. and 6 a.m. and they must be used at a minimum distance of 1 km from the nearest dwellings.
Soil and Surface Water-related Measures: The contractor will define and equip the area concerned by the earthworks or storage of materials with a drainage system along its perimeter, flowing into a sedimentation pond to collect sediment before it is discharged into the water course. A management procedure will be established for those basins and the basin will be cleaned as soon as its active volume has been reduced by 50% by the accumulated sediment. Turbidity will be monitored at the entry to, and exit from each basin as well as in the Bandama upstream and downstream from the works in order to permanently assess the performance of the facilities. The Contractor will ensure the collection, temporary storage and disposal under environmentally acceptable conditions of used motor oil. Sedimentation ponds will be established to collect water from the transverse feeding augurs rich in concrete with pH adjustment (acid buffering acid) before being released into the environment.

Impact on the quality of water resources: The contractor shall prepare a water quality plan that will highlight the quality of the on-site environmental management. This monitoring concerns compliance monitoring which will be required at all points where liquid effluents (wastewater, drainage) leave the confines of the project sites concerned for the natural environment. The Contractor concerned will be required to ensure compliance with applicable Ivorian standards or, failing which, with recommended international standards. The Contractor will be responsible for carrying out, or having carried out by a competent entity, weekly monitoring of the quality of all its waste. The parameters will be defined on the basis of the type of waste and detailed as follows:
(i) wastewater and stormwater drainage from the living quarters; (ii) discharge from stormwater drainage networks on exiting the sedimentation ponds; (iii) stormwater drainage from the garage areas and maintenance of machinery on exiting the oil separators; (iv) discharge from specific sites such as the concrete equipment washing areas; and (v) monitoring of discharges form wastewater treatment facilities.

Measures against loss of habitats and plant and terrestrial animal species: A biodiversity Management and Action Plan is to be prepared. This plan will be prepared in detail as part of the Environmental and Social Management Plan during the project’s operational phase. A framework for this plan is provided. A restoration and rehabilitation area is proposed. The initial thinking is that the site would be located immediately downstream from the dam. It will be protected on one side by the hydro-power scheme and will be monitored from the right bank of the Bandama. The final selection of the restoration area will be settled after consultations with the local communities, civil society and local environmental authorities. This forest restoration aims to assist the natural forest restoration process by ensuring that the specific composition, structure of the forest stand, biodiversity, functions and dynamics of the restored forest correspond, to the extent possible, to those of the original forest.

Cultural heritage-related measures: the following recommendations are made: (i) the design of a major archaeological emergency programme entailing the conduct of detailed archaeological prospection and surveys and digs (of short duration: 21 days) before the start-up of the structural works, on the one hand and, on the other, almost permanent during the works excavation etc.; (ii) Periodic monitoring by a consultant archaeologist during the works period; (iii) triggering of the fortuitous discovery procedure in the event of the discovery of remnants or other items classified as cultural assets by the archeological expert and methodical recovery of the archaeological remnants discovered. This would comply with the provisions of Article 5, Chapter 2 (Section 4) of Act 87-806 of 27 July 1987 as well as IFC PS 8 (iv) conservation and management of archaeological resources and establishment of an observatory and a database and archiving of archaeological resources.

Public Safety Measures: Public safety measures will be taken with respect to the reservoir. Access to the reservoir by the general public, especially children, will be prohibited to avoid any
risk of them being dragged towards the water intake screens and drowning. These measures will be bolstered by a sensitization programme for the riparian communities and residents of the O7M and employees’ campsites. A public hygiene plan will be prepared as part of the ESMP whose main thrusts and guidelines are presented in Annex to this report.

In addition to the good environmental and social management practices that will be applied during the works and the operational phase, the different negative impacts identified will be mitigated by the following specific management plans:

- **Contractor’s Hygiene, Health, Safety Environment Plan**: A Hygiene, Health, Safety, Environment (HHSE) Plan will be prepared and implemented by the Construction contractor to protect the natural environments against sources of pollution from site activities to ensure safe and healthy working conditions for workers and to prevent, avoid or reduce risks and impacts on the health and safety of the local communities in the environs. In the context of the Singrobo-Ahouaty Hydropower Development Plan the HSSE will include: (i) A description of the contractor’s human and material resources for environmental and social protection in accordance with the ESMP; (ii) A training and sensitization plan for personnel on on-site HSSE obligations; (iii) Description of responsibilities for site-related health issues (training, monitoring and sensitization on HIV/AIDS, STD, bilharzia and malaria; (iv) waste management plan; and (v) traffic plan;

- **Waste Management Plan (hazardous and non-hazardous products)**: A chemical product management plan will be established in order to set out in detail the measures planned to minimize the risks of pollution. The programme will be applicable to all project activities involving handling, storage and the use of products listed as hazardous.

- **Excess Soil Management Plan**: The works contractor will be asked to propose a plan for these materials that complies with the objectives of minimizing volumes, re-use, adequate storage, etc.

- **Plan relating to accidental spillage or any other major incident**: A pollution control programme will be prepared in order to define intervention procedures in the event of leakage or accidental spillage of liquid products. This programme will include a description of the planned organization in the event of intervention and work stations of key persons. Specific training on the activities to be developed in the event of an emergency intervention will be provided for all employees involved in a stage of the procedure.

- **Erosion and Sedimentation Management Plan**: Control of stripped or excavated land, embankments and temporary or permanent storage sites established to minimize and control the resulting sediment loads before they reach the river. This protection will be achieved on the one hand by the use of slope stabilization methods and, on the other, for the harvesting of run-off water.

- **Site Revegetation and Rehabilitation Management Plan**: Soil protection by revegetation will be carried out on sites under construction (stabilization and erosion control) or on completion of construction (rehabilitation). An implementation programme will be prepared by the Contractor outlining the proposed methods and species used.
- **Living Quarters Management Plan:** A living quarter’s management plan will be prepared by the Contractor in charge and will include the justification for the selection of its location, organization, installations and supply methods and accommodation conditions, etc.

- **Public health management plan:** the concentration of a large population in an area with many health problems linked to hygiene, parasitic infections and STD required the implementation of a programme that will prevent the uncontrolled development of communicable infections or epidemics. The actions taken must prioritize the personnel employed. In order to optimize these actions, measures must be taken at the level of the local resident population. Control measures against water-borne diseases, epidemics and preventive health measures must be taken to ensure that the project complies with international good practices, mitigate the project’s health impact and also to capitalize on it to improve healthcare coverage which is currently very low.

- **Air Emissions, Dust and Noise Management Plan:** A programme to reduce air emissions, dust and noise will be established in all the areas likely to be affected by the construction work, in particular close to construction sites and along the access roads. Gas and smoke emissions will be limited by mandatory maintenance of machines and trucks. The burning of all waste (with the exception of woods or non-recycled paper) will be prohibited on-site.

- **Road Traffic and Access Management Plan:** Road traffic is the main cause of accidents during the construction phase for major infrastructure. It must, therefore, be regulated on and off-site.

- **Borrow Area Management Plan:** It is possible that new borrow areas or quarries are opened during the construction works for the production of laterite or other materials. This plan will show the sites, the ESIA/ESMP including the population consultation procedure;

- **Cultural Resources Management Plan:** in addition to the measures mentioned above, it will be necessary to establish a fortuitous discovery procedure.

- **Water Quality Management Plan:** The Contractor will prepare a water quality monitoring plan the objective of which will be to highlight the quality of environmental monitoring carried out on the sites which entails monitoring of compliance, that is, it will be imposed at every point where liquid effluents (wastewater, drainage) leave the confines of the project sites concerned to be discharged into the natural environment. The contractor concerned will be required to comply with applicable Ivorian standards or, failing which, recommended international standards.

- **Biodiversity Management and Action Plan:** IHE intends to establish in close collaboration with the local population, civil society and the competent services a Biodiversity Action Plan. One measure to be included in this plan is the creation of a biological restoration zone. The plan’s finalization will be an integral part of the ESAP.

- **Fisheries Development/Reorganization Plan:** The fisheries development ‘reorganization plan will be mainly focused on the study to define the plan, capacity
building for the Taabo Fisheries Directorate support to fishermen and would-be fishermen, offloading facilities, processing and marketing and the partial deforestation of the reservoir.

- **Stakeholder Engagement Plan (SEP):** this presents the information, consultation and document disclosure plan proposed by the Project developer, the Ivorian Hydro-Power Company (IHE).

**Communications Procedure:** the internal communications procedure will focus on periodic exchanges (daily, weekly, monthly or quarterly) between the project task managers and site supervisors (IHE, BC and the construction contractor, the REM (IHE), the REBC (BC) and REE (Construction contractor). The external communications procedure will remain IHE’s through the REM assisted by the communications head and communications officer with the local communities (LC). This communication will mainly concern exchanges of information with the media, local communities, NGOs and central government representatives.

**Procedure for handling non-conformities:** A key factor in the communication process between the parties concerns the ranking of events which do not meet the project’s assigned environmental obligations and objectives.

**Recruitment Procedure:** It is recommended to open decentralized recruitment centres in the headquarters of the sub-prefectures of Taabo and Pacobo, and the largest urban centres near the sites. The construction contractor and its sub-contractors will carry out the recruitment of unskilled or little skilled labour while skilled labour will be recruited by the appropriate structures.

**Estimated Cost of ESMP**

<table>
<thead>
<tr>
<th>Measures/Action Plan</th>
<th>Cost in CFAF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir Deforestation Plan</td>
<td>19 650 000</td>
</tr>
<tr>
<td>Establishment of ESMS</td>
<td>131 000 000</td>
</tr>
<tr>
<td>Equipping of O&amp;M and employees camp-sites with sanitation systems</td>
<td>32 750 000</td>
</tr>
<tr>
<td>Measures to prevent public safety risks (terminals on the banks and an overhead cable, alert system, information on radios, etc.). Sensitization of populations on hazards related to the operation of the structures</td>
<td>65 500 000</td>
</tr>
<tr>
<td>Measures against public health risks and sensitization programme (sensitization campaigns, distribution of insecticide treated bed-nets, establishment of a monitoring committee, etc.)</td>
<td>65 500 000</td>
</tr>
<tr>
<td>Solid waste management plan</td>
<td>65 500 000</td>
</tr>
<tr>
<td>Invasive plant control programme (biological control, removal , enhancement)</td>
<td>131 000 000</td>
</tr>
<tr>
<td>Capacity building programme (EHSS)</td>
<td>32 750 000</td>
</tr>
<tr>
<td>Measures relating to dam failure risk</td>
<td>65000000</td>
</tr>
<tr>
<td>Control of guaranteed instream flow (1 flow rate measurement station)</td>
<td>9 825 000</td>
</tr>
<tr>
<td>Monitoring of fish farming species in the future reservoir</td>
<td>65 500 000</td>
</tr>
<tr>
<td>Monitoring of vectors of water-borne diseases</td>
<td>19 650 000</td>
</tr>
<tr>
<td>Survey of managers of protected areas</td>
<td>9 825 000</td>
</tr>
<tr>
<td>Monitoring of river and reservoir water quality</td>
<td>65 500 000</td>
</tr>
<tr>
<td>Independent auditor to audit the implementation of the ESMP (5 years)</td>
<td>65 500 000</td>
</tr>
<tr>
<td>Biodiversity Management and Action Plan</td>
<td>85 150 000</td>
</tr>
<tr>
<td>Closer monitoring of Classified forest area</td>
<td>9 825 000</td>
</tr>
<tr>
<td>Improvement of village collective infrastructure</td>
<td>163 750 000</td>
</tr>
<tr>
<td>Support for improved crop yields</td>
<td>65 500 000</td>
</tr>
<tr>
<td>SEP (excluding amount included in that of the RAP)</td>
<td>18 000 000</td>
</tr>
<tr>
<td>Cultural Heritage Protection Plan</td>
<td>75 000 000</td>
</tr>
<tr>
<td>RAP</td>
<td>9 668 850 158</td>
</tr>
<tr>
<td><strong>TOTAL ESMP</strong></td>
<td><strong>11 094 275 158</strong></td>
</tr>
</tbody>
</table>
7. **Supervision/monitoring of Environmental and Social Management Plan and Cost of ESMP**

### 7.1 Construction Activity Monitoring

The BC, through the REBC, is the entity that will carry out environmental supervision as it certifies payments and may negotiate the intervention of equipment or labour originally allocated to works for specific environmental measures.

Compliance by the Construction contractor and its sub-contractors with their environmental and social obligations will be the subject of specific monitoring coordinated by the REBC. In order to ensure the efficiency of the proposed mitigation measures including compliance with the recommendations during the works phases, an environmental supervision programme will be established comprising: (i) environmental supervision by the Construction contractor and its sub-contractors: The objective is to control the smooth implementation of social and environmental measures described in the obligations of the project service providers and action plans provided by these providers; (ii) monitoring of environmental quality: the objective is to monitor the trend in environmental quality, in order to assess the effectiveness of the mitigation measures implemented and to modify if necessary the acceptability thresholds or methods; this concerns as a priority the quality of river water downstream form the works sites; (iii) monitoring of compliance of discharges: the objective is to verify that discharges from the project sites are compliant with environmental legislation or the specifications.

**Weekly inspections:** A weekly inspection of the different works sites will be organized by the REBC and will be the subject of a report using standardized inspection sheets. This sheet will repeat item by item the environmental specifications making it possible to remove possible non-conformities during each inspection.

**Mobilization of an Independent Auditor:** This will be the responsibility of IHE which will mobilize an independent auditor (IA) at the request of donors (or financial partners). This IA which will include an Environmental Expert and a Social Expert will make periodic visits during the construction and operating period.

**Preparation of communications material – IHE:** To complement the public consultations it is important to rapidly develop communication materials that will enable IHE to present prior to the works start –up clear information on the project design, on the sequencing of the construction on the recruitment procedures as well as on environmental and social measures to be implemented.

### 7.2 Monitoring of activities during the operational phase

**Control of guaranteed instream flow:** unannounced inspections will be carried out by ANDE in the dry season to ensure that the guaranteed flow rate downstream from the dam is effectively released in compliance with the contractors’ specifications.

**Monitoring of fish-farming species:** Fish-farming species in the reservoir and downstream from the Singrobo-Ahouaty hydropower dam will be monitored by IHE and by ANDE. The programme will be established in order to assess the impact of the structures on the number of species in the river in the reservoir area and downstream from the dam. Two (02) samplings will be made during the first two years, one on the dry season and one in the rainy season.
**Monitoring of vectors of waterborne diseases**: this activity which will be carried out by ANDE, will focus specifically on the annual inventory of aquatic vegetation which will develop around the reservoir and on the presence in this vegetation of mosquitoes and certain gastropod species that could be intermediate hosts for vectors of malaria and bilharzia.

**Study on water quality – IHE**: Because of ESIA implementation constraints, only a few periodic samplings were carried out. It is important to establish a more consistent base for the natural variability of the quality of the Bandama waters on an annual cycle as a minimum. A study will be conducted with monthly sampling campaign over a minimum one (1) year period. Two sampling points are proposed: stations 6 and 3 identified during the study on the aquatic environment.

### 8. Public Consultations and Disclosure

#### 8.1 National and AfDB requirements

Public participation falls within the regulatory framework of Decree No. 96-894 of 08 November 1996 laying down the rules and procedures for impact assessments of development projects. It comprises two phases: (i) the public information and consultation session meeting at which the Project partners exchange with local authorities and local populations in order to gain their acceptance of the project’s implementation. A common strategy will be defined for the project’s implementation in a concern to protect the natural and human environment. (ii) a public enquiry which consists of making available to the public the report of the Environmental Impact Assessment under the supervision of an Investigating Commissioner appointed by municipal bye-law and responsible for collecting comments from the public. This regulation will ensure that the project is implemented using a participatory process.

According to AfDB’s 2013 ISS, throughout the environmental and social assessment process, the Bank undertakes to ensure that the borrower or client organizes transparent consultations with the affected communities in particular with vulnerable groups, in order to allow them to participate in a free, prior and informed manner in decisions concerning the prevention or management of environmental and social impacts. (i) Free: of intimidation and coercion; (ii) prior: timely in terms of the assessment process, allowing sufficient time to access information, understand it and prepare responses; (iii) informed: advance availability of relevant, understandable and accessible information in the appropriate language. As shown in the following sections, these requirements were complied with in relation to the ESIA and Resettlement Plan.

#### 8.2 Public Consultations as part of the preparation and validations of the ESIA/ESMP

In the context of this study a participatory process was adopted. It consisted at a public meeting presided over by the highest administrative authority (i.e. the Prefect of Taabo Department), of presenting the project, teams, method of intervention and the population’s expectations before gathering their concerns and expectations at an exchange of views.

##### 8.2.1 First Series of Consultations

The first series of consultations (initial consultations), carried out at the start-up of the studies. These mainly aim to:

- Inform the stakeholders on the project itself (technical characteristics, objective, public interest);
- Inform stakeholders on the team responsible for conducting the impact assessment and the resettlement plan, - inform the stakeholders on the investigations to be
carried out in the field, and, in particular, materialization in the field of the expropriation procedure as well as identification and inventory of PAP assets;

- Maintain contacts with the local authorities and traditional village chiefs in particular at the time of land surveys (prior information and appropriate consultations); and
- Gather the views and opinions expressed on the project.

Following the initial series of consultations the main issues concerned the following themes:

- Compensation modalities;
- The project right-of-way limits;
- Management of claims and land disputes;
- The programme of enquiry missions.

8.2.2 Second Series of Consultations

The second series of consultations was carried out on the basis of the provisional study findings, especially concerning:

- The proposed modalities for the resettlement of PAP and the eligibility criteria for the resettlement plan,
- The description of the project impacts and the measures taken to eliminate, mitigate or compensate for the environmental and social impacts.
- Information is disclosed at public meetings in Taabo and meetings held in the villages of Singrobo, Pacobo, Ahérémou 2, N’dénou and Ahouaty.

A public meeting was organized in Taabo on 7/09/2016 to validate the ESIA results and meetings held in the five riparian villages. After statements by the representatives of Taabo’s mayor, the Minister of Culture and la Francophonie, the Minister of Oil and Energy, the CEO of IHE and the Secretary-General of the Prefecture representing the Prefect of Taabo, the main conclusions of the ESIA were presented by BNETD, following the showing of an institutional film by HUDDA.

On the whole, the presentations concern the presentation of the project, the presentation of the methodological approach, the description of the main components of the natural and socio-economic environments of the project area, the counting of PAPs and the inventory of land, agricultural, property and cultural assets, the presentation of the conditions of eligibility of PAPs for the RAP, compensation measures retained, etc. At the end of the ESIA and RAP results validation mission, the lists of PAPs were submitted to the prefectural authorities (Prefecture and Sub-prefectures) and customary authorities of the five riparian villages. The results of the public consultation activities were the subject of reports in annex to the ESIA and RAP reports submitted to the project owner (IHE) and sometimes to the prefectural authorities.

In general, all the actors expressed their full approval of the project. The administrative authorities are fully determined to support the implementation of the project desired and supported by the central government of Côte d’Ivoire. However, the administration wants the needs expressed by the riparian communities of the future Singrobo-Ahouaty dam to be taken into account, in particular adequate sizing of the embankment to allow the circulation of heavy duty vehicles, the installation
of the security checkpoint to facilitate traffic fluidity and prevent the frequent accidents at this part of the Taabo dam. The administration highly recommends the timely compensation of project affected people, and the recruitment of local labour to perform menial tasks. The main concerns and expectations of stakeholders in the project are contained in the minutes of public meetings and working sessions with the administrative services which appear in the stakeholder engagement plan.

Table 3
below summarizes the different meetings and consultations held under the project to-date:

<table>
<thead>
<tr>
<th>Type of Meeting</th>
<th>Locality</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official ESIA and RAP launching</td>
<td>Taabo</td>
<td>03/12/2015</td>
</tr>
<tr>
<td>mission</td>
<td>Ahouaty; N’Denou; Ahérémou 2; Pacobo;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Singrobo</td>
<td>19/01/2016 – 27/01/2016</td>
</tr>
<tr>
<td>Meetings with Communities</td>
<td>Ahouaty; N’Denou; Ahérémou 2; Pacobo;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Singrobo</td>
<td>19/04/2017 - 28/04/2016</td>
</tr>
<tr>
<td>Public Meetings</td>
<td>Pacobo and Taabo</td>
<td>30/03/2016</td>
</tr>
<tr>
<td>Socio-economic surveys</td>
<td>Ahouaty; N’Denou; Ahérémou 2; Pacobo;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Singrobo</td>
<td>19/04/2017 - 28/04/2016</td>
</tr>
<tr>
<td>Consultation meetings</td>
<td>Taabo, Ahouaty; N’Denou; Ahérémou 2;</td>
<td>07/09/2017 – 09/09/2017</td>
</tr>
<tr>
<td></td>
<td>Pacobo; Singrobo</td>
<td></td>
</tr>
<tr>
<td>fishermen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural survey with village</td>
<td>N’Denou, Ahouaty, Ahérémou 2; Pacobo and</td>
<td>29/12/2016 – 31/12/2016</td>
</tr>
<tr>
<td>chiefs</td>
<td>Singrobo</td>
<td></td>
</tr>
<tr>
<td>Additional consultations (focus</td>
<td>Taabo, Singrobo, Pacobo, N’dénou, Ahérémou</td>
<td>25/7/17 - 29/7/17</td>
</tr>
<tr>
<td>groups, open days)</td>
<td>Ahouaty</td>
<td></td>
</tr>
</tbody>
</table>

The public enquiry which consists of making available to the public the ESIA report under the supervision of an Investigating Commissioner appointed by municipal bye-law and responsible for gathering the public’s observations was held on 22 June 2017 and closed on 4 July 2017. The populations were informed at national level through the media (newspapers and website) and local radios. The ESIA and RAP reports were disclosed locally. The preceding interministerial validation meeting was held on 7 September 2017. The certificate of compliance is expected by the end of October 2017.

8.3. **Practical arrangements for consultation for the remaining stages and grievance management: Stakeholder Engagement Plan**

Implementation of the SEP falls under the responsibility of IHE, the project sponsor. IHE will assign at least one employee based locally to the organization of consultation, grievance management and coordination actions at the Liaison when the latter is established at the living quarters established by the general contractor.

8.3.1 **Consultation Plan**

In order to avoid the duplication of efforts that could be prejudicial to the Project and the communities concerned, it is important, in the case of this project to harmonize the planned consultation modalities under Ivorian law with international standards. It is necessary to strengthen the consultation measures provided for under Ivorian law to ensure they are fully compliant with
international standards. A consultation plan was proposed for the finalization of the ESIA and RAP as well as their implementation.

8.3.2 Grievance Management Mechanism

The grievance management mechanism must be established by the Project sponsor to enable all the stakeholders, in particular, those affected by the project to give their opinions on the project proposals to channel their concerns and thus gain access to information or seek redress or resolution. This mechanism must be efficient, accessible, predictable, equitable, transparent and compatible with human rights, based on engagement and dialogue, and allow all the parties concerned, including the project sponsor to draw lessons. Its scope concerns the entire operation with the exception of human relations which fall under a specific grievance management mechanism.

Two types of redress are possible:

- On the one hand, the amicable and extra-judicial mechanism established specifically by the project; and
- On the other hand, the judicial mechanism which results from the application of the 1930 decree on expropriation.

The preferred option for the settlement of the different cases of complaints and grievances recorded and those that might arise under this RAP is the amicable settlement. Two this end a mechanism comprising two levels of redress (internal and external with the intervention of a mediation organization) will be adopted. A standard complaints form is available in annex to the SEP.

The person designated by the IHE to receive complaints is:

Mr ETTY Ekolan Alain, CEO of IHE, Tel: 0022522413557

E-mail: ea.ett@ihecispv.com

8.3.4 Monitoring indicators and reporting:

Engagement actions will be monitored internally and will concern the following key indicators:

- Number of meetings of all kinds held in the month;
- Cumulative number of participants;
- Specific problems raised by meeting participants;
- Number of community incidents (type: blocking of access to site, demonstration, etc.….) in the month, duration of the incidents, number of people involved, with analysis of causes and description of actions taken to resolve the incident;

Grievances:

- Establishment of simple categories for the classification of grievances
- Example : compensation, employment, nuisances, others (to be adapted on the basis of
• Complaints effectively received;
• Number of complaints filed in the month by category;
• Number of complaints closed at the first level in the month by category;
• Average resolution time and evolution;
• Number of complaints submitted to the second level for mediation by category;
• Number of complaints closed following mediation by category; and
• Number of complaints giving rise to an ongoing judicial proceedings.

The following periodic implementation reports will be prepared by the RAP-IU:

- Monthly internal monitoring report on consultation activities that could be integrated into monthly environmental and social monitoring report on the basis of a standard plan to be prepared at the start of implementation and including the following indicators;
- Six monthly internal monitoring report on consultation activities consolidating the information provided in the monthly reports and presenting an analysis in terms of the effectiveness of the actions carried out. Lessons to be learnt and possible corrective actions.

9. Residual Impacts and Environmental Risk Management

9.1 Negative Residual Impacts

No negative residual impact of moderate or high impact is expected after implementation of the mitigation measures. The negative residual impacts are minor and will not be the subject of special measures.

9.2 Environmental Risk

The main environmental risks concern the risk of dam failure and the spread of disease.

With regard to the first risk, a dam failure analysis will be prepared. Flooding maps will be prepared to support the required emergency response plan. The hydrological and hydraulic study determined that the Singrobo-Ahouaty dam can successfully withstand the effects of a 10,000 year flood event. Also, the flood modelling results will be included in the emergency response plan to inform the competent authorities and to allow the preparation of emergency action plans and warning/evacuation procedures.

This emergency response plan will be finalized before the dam is filled and forms part of the project’s environmental and social action plan whose implementation is one of the Bank’s financing conditions. This plan specifies, among others: the role of the different responsible parties in the event of an imminent dam failure or when the estimated release flow poses a threat. This plan should comprise the following elements: (i) classification of the dam on the basis of its vulnerability; (ii) the level of consequences in the event of failure (dam breach study, mapping of floodable areas, etc.); (iii) safety standards relating to floodwaters and earthquakes (floodwater typology, seismic hazard maps, etc.); (iv) impounded water management plan, in particular when
situations are likely to jeopardize the safety of people and property (maximum operating level, evacuation curves, communications strategy, etc.) ; (v) a prevention plan including signaling, information’s and sensitization measures for workers and local populations in order to prevent risk of accidents and drownings especially during water releases; (v) an emergency measures plan (inventory of situations, risk classification, alert procedures, disclosure of information to the authorities and populations, etc.) ; (vi) a dam safety surveillance plan (reconnaissance visits, regular inspection, specific inspections, etc.) ; (vii) a dam register containing all the interventions made concerning the infrastructure; (viii) periodic independent safety assessments (verifying that all the above-mentioned factors are taken into account and updated); and (ix) a safety programme accompanied by the necessary authorizations and permits.

9.3 Climate Risks

The project was classified in Category 2 in accordance with the Bank’s climate screening system. The main risks likely to affect the water courses are: (i) a reduction in the available volume of surface water for the Bandama and Sassandra rivers from -21 to -22 % and from -5.10 to -8.35 % respectively; (ii) increase in sedimentation which is now 5 and 15 mm during the small rainy season and between 10 and 30 mm during the main rainy season. The accumulation of hydrological and hydraulic changes will create major disruptions to the use of water resources in the downstream stretch. This situation may raise problems of water for drinking, irrigation, electricity (existence of several potential hydro-power development sites downstream from the future Singrobo-Ahouaty dam). The design factors that would help to build the project’s resilience are:

- Guarantee an environmental flow downstream from the future dam to take into account the impacts of climate change on the use of the resource downstream. A minimum flow rate of 78 m³/s and floodwater flow rate of 450 m³/s will be guaranteed; and
- An appropriately sized and well-designed spillway will be installed to allow a floodwater evacuation rate of 2,745 m³/s corresponding to 10,000 year return periods. This provision will contribute to flood risk management;

Concerning the mitigation component, the outcome of the Singrobo-Ahouaty Hydro-power Development Project will be an annual reduction of 109,561 t eq CO2.

10. Institutional Capacities

9.1 ESMP and RAP Monitoring Capacities and Arrangements at IHE Level

The management of environmental and social aspects will be the responsibility of an M&E expert, an engineer and liaison officer with the local communities (LC) who will be based on-site with frequent visits to Abidjan.

This team will be responsible for:

- The development and establishment of the ESMP;
- The coordination and implementation of the Resettlement Action Plan; and
- The conduct of all consultations with the local communities and project stakeholders;
- The establishment of the grievance processing mechanism;
• Training for the personnel of IHE and its sub-contractors;
• Preparation of specific environmental and social studies;
• Project monitoring and monitoring of compliance with applicable environmental and social standards;
• Project environmental and social performance; and
• Prepare environmental and social monitoring reports.

This team will be assisted by international environmental and resettlement experts. It will also be assisted during RAP implementation by an international expert, a local NGO and community facilitators.

9.2 Capacity Building Plan:

It is planned to provide environmental and social training during all the project phases:

• In the construction phase, training of the contractor’s personnel and sub-contractors.

A training plan will ensure the smooth implementation of the measures proposed in the ESMP on the construction sites. This plan will define general training programmes (sensitization) for all personnel and specialized training programmes for employees involved in activities that are particularly sensitive from an environmental standpoint (hydrocarbon management and distribution, hazardous waste management landfill site management, etc.). Each new recruit will participate in the sensitization programme within ten (10) days of his/her recruitment. Each employee responsible for sensitive activities will attend a refresher session every six (6) months.

Training will be provided for all personnel in the most appropriate language. A register will be maintained in which the names of all the participants will be entered.

The environmental management sensitization programme on the sites will cover the following priority subjects:

- waste management rules within the site confines;
- Rules for hazardous product and waste managements, especially their storage solely authorized on specially prepared areas;
- pollution control and especially the behaviour to be adopted in the event of accidental spillage of pollutants;
- Protection of biodiversity, requiring the complete prohibition of hunting and the introduction of weapons and traps onto the site and bringing of any fishing gear within the boundaries of the living quarters, prohibition of the consumption of bush meat in the living quarters, prohibiting of the gathering of wood or non-wood species, prohibition of lighting fires in wooded areas which are not organized in the context of construction activities, a ban on being in possession of products
derived from endangered species, prohibition of introducing unplanned animal or plant species or spreading invasive plants;

- protection of sites against erosion or sedimentation;
- the procedure to be followed in the event of the discovery of a physical cultural resource;
- road safety rules on public roads and on sites;
- the principles of saving energy and other resources; and
- penalties to be applied in the event of infringement of the stipulated rules.

Additional information on hygiene, health, safety and the environment must be provided for all aspects not covered by the HSSE plan and by the related training.

- Training of IHE’s M&E team

The team will receive specific training on the tasks it will have to perform. Training requirements will be formulated as soon as the team is recruited and operational. The training is expected to include missions to sites and similar projects as well as targeted training sessions on project environmental and social management, health & safety aspects, population resettlement and social accountability. A budget of €50000 was originally estimated in the initial ESMP. Furthermore, and in addition to this training budget, a Consultant will assist the IHE M&E team in the performance of their tasks for at least 6 months and will participate in the training of this team on the project’s environmental and social management.

10. Conclusion

Overall, the study shows that the project will have significant positive impacts in terms of social spin-off. The project may also generate negative impacts; however, all the anticipated negative impacts are likely to be efficiently managed due to the correct implementation of the environmental safeguard measures formulated in the ESMP. The ESIA and RAP reports have been submitted for validation at national level. A certificate of compliance is being issued by the Ministry responsible for the Environment. Its submission to the Bank is part of the ESAP.

11. References and Contacts

The summary was based on the following documents:


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